Handbook on the Management of Population and Housing Censuses

Revision 2

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Abbreviations

API	application programming interface
BYOD	bring your own device
CAPI	computer-assisted personal interview
CATI	computer-assisted telephone interview
CSV	comma-separated values
ECE	Economic Commission for Europe
GIS	geographic information system
GPS	global positioning system
GSBPM	Generic Statistical Business Process Model
ICR	intelligent character recognition
ICT	information and communications technology
INECV	National Institute of Statistics of Cabo Verde
ISO	International Organization for Standardization
IT	information technology
NADA	National Data Archive
OMR	optical mark recognition
PC	personal computer
PDA	personal digital assistant
PDF	portable document format
RAM	random-access memory
SD	secure digital
SMS	short messaging service
SQL	structured query language
SWOT	strengths, weaknesses, opportunities and threats
UNFPA	United Nations Population Fund
W3C	World Wide Web Consortium
XML	extensible markup language

I. Essential characteristics of population and housing censuses

A. Introduction

1.1   Efficient management of the economic and social affairs of a country rests on evidence-based decision-making. Generating relevant, accurate and timely statistics is essential to this model; producing detailed statistics for small areas and small population groups is its foundation. The role of the population and housing census is to collect, process and disseminate such small-area detailed statistics on population and its composition, characteristics, spatial distribution and organization (families and households). In the majority of the countries in the world, censuses are conducted periodically – most commonly, once in 10 years.[1]

1.2   The *Principles and Recommendations for Population and Housing Censuses, Revision 3*,[2] defines the population census as the total process of planning, collecting, compiling, evaluating, disseminating and analysing demographic, economic and social data at the smallest geographical level pertaining, at a specified time, to all persons in a country or in a well-delimited part of a country. In the case of a housing census, this same process focuses on statistical data relating to the number and condition of housing units and facilities as available to the households pertaining, at a specified time, to all living quarters and occupants thereof in a country or a well-delimited part of a country.

1.3   Before determining the need for a census, it is important that there be an understanding of the role of the census (box 1), both in terms of what is possible through the selected census enumeration process and how the census itself fits into the overall statistical framework of the country. Because of the high profile of the census compared with other statistical activities, many users may view the census as either the sole source of statistics or the only reliable source of statistics about a particular topic. The key strength of a census compared with many other statistical collections is the ability to provide data for small geographical areas and for small population groups.

1.4   The prime role of a census is usually to provide an accurate count of the total population for each of the administrative regions of a country. In terms of public administration, such counts are required for equitable distribution of funds and the electoral process. A census usually also collects information on characteristics of the population (such as age and employment) and their housing, to help to ensure that the allocation of funds meets the needs of different regions and

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[1] As a rule since its inception, the United Nations recommends that each country conduct a population and housing census at least once in a 10-year period, usually within the so-called census round. The 2020 census round covers the 10-year period 2015–2024.

[2] *Principles and Recommendations for Population and Housing Censuses, Revision 3* (United Nations publication, Sales No. E.15.XVII.10), United Nations Statistics Division, New York, 2017.

population groups. The census also represents an irreplaceable frame for developing and implementing the collection of other statistics within the national statistical system.

Box 1. Roles of a census

According to the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, the following are some of the essential roles of a census.

(a)   **Public administration.** The results of a census are used as a critical reference to ensure equity in distribution of wealth, government services and representation nationwide, including distributing and allocating government funds among various regions and districts for education and health services, delineating electoral districts at the national and local levels, and measuring the impact of industrial development. Establishing a public consensus on priorities would be almost impossible to achieve if it were not built on census counts. A wide range of other users, including the corporate sector, academia, civil society and individuals, make use of census outputs.

(b)   **Master sampling frame.** The census also plays an essential role in all elements of the national statistical system. Census statistics are used as benchmarks for statistical compilation or as a sampling frame for sample surveys. Without the sampling frame and population benchmarks derived from the population and housing census, the national statistical system would face difficulties in providing reliable official statistics for use by the Government and the general public.

(c)   **Small-area estimates.** The basic function of the census is to generate statistics on small areas and small population groups with no or minimum sampling errors. While statistics on the small areas are useful in their own right, they are important because they can be used to produce statistics on any geographical unit with arbitrary boundaries.

(d)   **Benchmark.** The census results are used as a benchmark for research and analysis. Population projections are one of the most important analytical outputs based on census data; future population projections are crucial for all segments of the public and private sectors.

Source: *Principles and Recommendations for Population and Housing Censuses, Revision 3* (United Nations publication, Sales No. E.15.XVII.10), para. 1.2.

B.   Definitions and essential features

1.   Population census

1.5   A population census is the total process of planning, collecting, compiling, evaluating, disseminating and analysing demographic, economic and social data at the smallest geographical level pertaining, at a specified time, to all persons in a country or in a well-delimited part of a country.

1.6   Population is basic to the production and distribution of material wealth. In order to plan for, and implement, economic and social development, administrative activity or scientific research, it is necessary to have reliable and detailed data on the size, distribution and

composition of population. The population census is a primary source of these basic benchmark statistics, covering not only the settled population but homeless persons and nomadic groups as well. Data from population censuses should allow presentation and analysis in terms of statistics on persons and households and for a wide variety of geographical units, ranging from the country as a whole to individual small localities or city blocks. In contemporary practice, georeferenced population and housing census data have become instrumental in developing statistical grids, which provide a more sensitive and powerful analytical tool for analysing socioeconomic and environmental phenomena independently of administrative boundaries.

2. Housing census

1.7   A housing census is the total process of planning, collecting, compiling, evaluating, disseminating and analysing statistical data relating to the number and condition of housing units and facilities as available to the households pertaining, at a specified time, to all living quarters[3] and occupants thereof in a country or in a well-delimited part of a country.

1.8   The census must provide information on the supply of housing units together with information on the structural characteristics and facilities that have a bearing upon the maintenance of privacy and health and the enjoyment of the right to an adequate standard of living. Sufficient demographic, social and economic data concerning the occupants must be collected to provide a description of housing conditions and also to offer basic data for analysing the causes of housing deficiencies and for studying possibilities for remedial action. In this connection, data obtained as part of the population census, including data on homeless persons,[4] are often used in the presentation and analysis of the results of the housing census, if both operations are conducted together or there is a link between them.

3. Essential features

1.9   The essential features of population and housing censuses are individual enumeration, universality within a defined territory, simultaneity, defined periodicity and capacity to produce small-area statistics.

3.1   Individual enumeration

1.10   The term "census" implies that each individual and each set of living quarters is enumerated separately and that the characteristics thereof are separately recorded. Only by this procedure can the data on the various characteristics be cross-classified. The requirement of

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[3] For the definition of "living quarters", see *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 4.421.

[4] For the definition of "homeless persons", see *Principles and Recommendations for Population and Housing Censuses, Revision 3,* para. 2.37.

individual enumeration can be met by the collection of information in the field, the use of information contained in an appropriate administrative register or set of registers, or a combination of those two methods.

3.2   *Universality within a defined territory*

1.11   The census should cover a precisely defined territory (for example, the entire country or a well-delimited part of it). The population census should include every person present or residing within its scope, depending upon the type of population count required. The housing census should include every set of living quarters irrespective of type. This does not preclude the use of sampling techniques for obtaining data on specified characteristics, provided that the sample design is consistent with the size of the areas for which the data are to be tabulated and the degree of detail in the cross-tabulations to be made.[5]

3.3   *Simultaneity*

1.12   Each person and each set of living quarters should be enumerated as of the same well-defined point in time, and the data collected should refer to a well-defined reference period. The time reference period need not, however, be identical for all of the data collected. For most of the data, it will be the day of the census; in some instances, it may be a period prior to the census.[6] In the case of population censuses derived from population registers, the interpretation of simultaneity follows the logic of the administration of population registers regarding the deadlines of registration procedures. As the present handbook focuses primarily and almost exclusively on the concept of the traditional population and housing census – that is, under the concept that each household in the country is approached with a request of providing information, irrespective of the method used for data collection – simultaneity as an essential feature follows the notion of the "census moment", a very specific point in time to which all the census counts and characteristics should refer to.

3.4   *Defined periodicity*

1.13   Censuses should be taken at regular intervals so that comparable information is made available in a fixed sequence. A series of censuses makes it possible to appraise the past, accurately describe the present and estimate the future. It is recommended that a national census

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[5] Reference is made here to the fact that a number of countries are using a short- or long-form paradigm, whereby the short form is administered to all the population and living quarters, whereas the long form, much more comprehensive in terms of topics covered, is administered only to a sample of population and living quarters.

[6] For example, collecting the information on the core topic of household deaths in the past 12 months, see *Principles and Recommendations for Population and Housing Censuses, Revision 3,* para. 4.250.

be taken at least every 10 years.[7] Some countries may find it necessary to carry out censuses more frequently because it is mandated by legislation or it is found necessary owing to the rapidity of major changes in their population or its housing circumstances.

1.14 The census data of any country are of greater value nationally, regionally and internationally if they can be compared with the results of censuses of other countries that were taken at approximately the same time. Therefore, countries should make all efforts to undertake a census in years ending in "0" or at a time as near to those years as possible. It is obvious, however, that legal, administrative, financial and other considerations often make it inadvisable for a country to adhere to a standard international pattern in the timing of its censuses. In fixing a census date, therefore, such national factors should be given greater weight than the desirability of international simultaneity.

3.5 *Capacity to produce small-area statistics*

1.15 The census should produce data on the number and characteristics of the population and housing units down to the lowest appropriate geographical level, compatible with national circumstances, and for small population groups, all the while protecting the confidentiality of personal information on each individual. In addition, most countries compile census data for special geographical areas not nesting perfectly into the administrative hierarchies that are used for different purposes (for example, flooding zones, health regions, labour market areas, electoral districts, postal zones, economic census units, or water or electricity supply districts). In some countries with reliable geo-referenced address registers, the census is also expected to yield grid square data for the main characteristics as a complementary population and housing census output.[8]

C.   Relevance to user needs

1.16 Ensuring that the needs of data users are carefully considered is an essential element of census planning. Since a census enumeration is among the largest and most expensive exercises undertaken by a country during peacetime, it is crucial to consult with data users. Such consultation is also a positive public relations undertaking and an efficient, transparent means of determining the demand for potential census topics.

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[7] As much as countries strive to follow the recommendations to conduct censuses within a strict periodicity in order to establish for more accurate benchmarks, it was documented in the previous census rounds that countries postponed their censuses fairly often because of constraints or shifting priorities.

[8] In the *Conference of European Statisticians Recommendations for the 2020 Censuses of Population and Housing*, European Union countries are strongly urged to produce data per 1 km² grid square as a key census output.

1.17   In line with the overall approach to the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, the selection of census topics is based on the outputs expected to be produced by the census. Therefore, the first step involves the clear identification of users' requirements for data; the core and additional topics are then decided on that basis. The topics to be covered in the census (that is, the subjects regarding which information is to be sought for each individual or household) should, however, be determined upon a balanced consideration of:

(a) The needs of the broad range of data users in the country at both the national and local levels (national priority);

(b) The achievement of the maximum degree of international comparability, both within regions and on a worldwide basis (international comparability);

(c) The sensitivity of the topics and respondent burden, that is, the willingness and ability of the public to give accurate information on the topics (suitability);

(d) The technical competence of the enumerators in obtaining information on the topics (suitability);

(e) The total national resources available for conducting the census (resources);

(f) Comparability with the previous census(es);

(g) The availability of and access to relevant information held in alternative data sources (alternative sources).[9]

1.18   Once the census agency has determined its position on census content, it needs to prepare and disseminate an information paper. The information paper should outline:

(a) The topics planned for inclusion in the forthcoming census;

(b) The topics planned for exclusion from the forthcoming census, with elaboration of the rationale for exclusion;

(c) Other topics, to assess user demand.

1.19   To assess the demand for data on particular topics, the census agency should solicit submissions from users on topics that should be included in the census. If at all possible, the release of the information paper should be supported by seminars held with users. Seminars provide the census agency with the opportunity to meet users of census data and to provide them with an indication of what topics can and cannot be realistically included in the census. In the majority of countries, other government ministries will be among the major users of census data

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[9] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 4.2.

and these seminars provide an opportunity to educate the staff from these ministries about the uses and limitations of census data.

D.   Uses of census data

1.20   Various stakeholders use census data for a variety of purposes. For public administrators, census data can highlight the need for public schools, libraries and medical centres in a region. They can provide information about infrastructure needs, such as electricity and water. Businesses can use census data to analyse the best places to locate their manufacturing units in keeping with their labour requirements or decide on the location of retail outlets depending on their target customers. Population counts are also important to monitor development, since they contribute to the denominators of various economic, social and health indices. Information on migration flows, citizenship, educational attainment, employment, disability, and mobile phone and Internet use at the lowest geographical levels also helps stakeholders to plan various programmes and projects to address needs. Apart from the Government, donor groups are able to determine funding levels and programmes on the basis of results from a census.

1.21   The census is the backbone of the national statistical system. Most countries conduct sample surveys between censuses as part of their household survey programme. Detailed small-area counts from the census may be used directly in the design of the sampling frame and the selection of the sampled units. The data from these surveys are usually more complex than the basic data collected in the census and are used to expand on the characteristics of census topics (plus additional topics) and to measure change between censuses.

1.22   Another common use of the results of the census is to provide a basis for estimates and projections of the population of a country. Such estimates will be required for years when a census is not held and may also be used to adjust census results to overcome problems such as underenumeration in the census. In addition, these estimates provide benchmark data for measuring change through the survey programme.

1.23   In the context of the international development agenda, census statistics represent an indispensable primary source of data needed for formulating, implementing and monitoring policies and programmes aimed at inclusive socioeconomic development and environmental sustainability. Population and housing censuses are a crucial source for monitoring progress in the implementation of the 2030 Agenda for Sustainable Development, adopted by the United Nations General Assembly with resolution 70/1 on 25 September 2015 and consisting of 17 Sustainable Development Goals and 169 targets. They are an important source for supplying disaggregated data needed for the measurement of progress, especially in the context of assessing the situation of people by income, sex, age, race, ethnicity, migratory status, disability, geographical location or other characteristics.

1.24   The data revolution called for in the report of the High-level Panel of Eminent Persons on the Post-2015 Development Agenda[10] is aimed at improving the quality and availability of data, thereby leading to more empowered people, better policies, better decisions and greater participation and accountability. For this purpose, the Panel envisions the integration of data from existing traditional sources, such as censuses and household surveys, with those from new sources, such as mobile phones, the Internet, social media and sensor-enabled objects, and other sources, such as qualitative data and citizen-generated data. In this context, the census remains central to the efforts to harness the data revolution for sustainable development, evidence-based decision-making and accountability at subnational, national, regional and global levels.

E.   Strategic objectives

1.25   Strategic objectives[11] of a population and housing census refer to a set of strategic aims and objectives that may be used to guide the implementation of the plans, set standards and form a set of benchmarks against which outcomes can be assessed to help to determine the success of the census. Ideally, the starting point for developing these objectives would lie in combining information derived from evaluating previous census experience, from understanding user requirements for information from the census and from assessing changes in both society and technology. In practice, some of this information is difficult to obtain and often provides conflicting guidance. Nevertheless, such objectives can be used to assist in planning major elements of the process. Although the strategic objectives of the census will be specific to individual countries and will differ according to local circumstances, they can be described under the headings census content, impact on the public and on the census staff, production of census results, cost-effectiveness and cost-benefit analysis.

1.26   **Census content.** The aim is to ensure that the topics are appropriate for meeting the demonstrated requirements of users, taking into account considerations of cost-effectiveness, human resources, time availability and respondent burden. Subsidiary objectives under this element relate to: (a) suitable consultation with existing and potential users at all stages; (b) the establishment of measurable standards of reliability incorporating user views on priorities; and (c) adequate testing of new topics to ensure the successful collection and production of reliable results.

1.27   **Impact on the public and on the census staff**. The aim is to ensure that all the aspects of collection operations and the dissemination of results are acceptable to the public and fully comply with legal and ethical standards for protecting the confidentiality of individual responses.

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[10] *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development*, Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, United Nations, 2013.

[11] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 2.7–2.14.

The public should be fully informed about census objectives, content and methods, as well as about their rights and obligations with respect to the census. Similarly, all census staff must be fully aware of their responsibilities. Subsidiary objectives include such issues as: (a) keeping completed forms and other records containing personal information secure and confidential; (b) ensuring that public support for all aspects of the census is as strong as possible; and (c) producing requested customized output in a manner consistent with the non-disclosure of personal information, adhering to established reliability standards for the release of data, and implementing policies designed to safeguard the access of all users to census results.

1.28   **Production of census results.** The aim is to deliver census products and services and to meet legal obligations and user' needs with stated quality standards and a predetermined timetable. Subsidiary objectives include: (a) producing outputs with a minimum of errors suitable for the purposes for which the data are to be used; (b) providing standard outputs for the main results and services for customized output; (c) providing access to output; (d) using geographical bases appropriate for collecting and referencing data for output; (e) improving methods of enumeration, particularly in difficult areas, so as to reduce levels of undercoverage and response error; (f) improving methods of evaluation and the means to convey findings to users; and (g) developing a measure of quality and targets.

1.29   **Cost-effectiveness.** The aim is to plan and carry out a census as inexpensively as possible without compromising the other strategic objectives. Subsidiary objectives relate to minimizing costs by: (a) adopting more efficient data-collection, data-capture and data-processing approaches and related technology; (b) contracting out appropriate parts of the operation; (c) exploring possible sources of alternative funding and, if appropriate, developing proposals for cost recovery and income generation; (d) international collaboration and reuse of systems; (e) encouraging the public to self-complete forms online or on paper where possible; and (f) replacing direct collection of data with use of administrative data.

1.30   **Cost-benefit analysis.** The aim is to increase the value or benefit generated from the census while also managing the overall cost. Increasingly, large programmes, such as the census, are expected to demonstrate or quantify the benefits that the programme will deliver. In effect, the value of the census should be greater than, or at least equal to, the cost of conducting the census. No programme can be considered a success unless the benefits of that programme are realized. The benefits from the census products and services are those that are realized through the uses of the census, some of which are outlined in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paragraphs 1.15 to 1.37. Some of the benefits generated through the use of the data can be quantified, while others are more difficult to measure but are nonetheless important and should be noted in any cost-benefit analysis for conducting a census. Some of these benefits depend on statistical agencies being open with information to encourage and inform debates about the effectiveness of Government and government policies. Ensuring that there is some identification of the benefits (whether estimated

in financial terms or not) and that the plans focus on realizing those benefits is therefore key to the planning of the census.

1.31   In the context of costs, it is of paramount importance to aim at emphasizing the benefits of the population and housing census in terms of the information that it generates. In essence, a cost-benefit analysis needs to be incorporated as one of the major components of the census so as to outline the costs of not having the necessary information and its consequences. While the benefits of the census and the statistics that it generates transcend local, regional and national needs and can and should be clearly quantified, there are also intangible benefits, such as national pride, in conducting such an exercise. Subsidiary objectives include illustrating the value of the census as an educational tool and framework, for comparative purposes at national and international levels and as a cornerstone of the national statistical system.

1.32   These objectives can serve as benchmarks to assess user requirements and may be built into appraisal systems that, with suitable weighting, can be used to compare and review options. Strategic objectives of the population and housing census need to be clearly emphasized throughout the process of preparing, conducting and exploiting census data.

F.   Compliance with international statistical standards

1.33   Adhering to international standards not only allows international and regional comparisons, it also provides a measure of national capabilities to implement them. If particular circumstances within a country require a departure from international standards, every effort should be made to explain these departures in the census publications and to indicate how the national presentation can be adapted to the international standards.[12]

1.34   International comparability is an important consideration in the selection and formulation of topics to be included in the census. National and international objectives are usually compatible, as the definitions and methods contained in international recommendations have successfully met general national needs in a wide range of circumstances. Furthermore, the analysis of census data for national purposes will often be facilitated if, through the use of international recommendations, it is possible to compare the data with those of other countries on the basis of consistent concepts, definitions and classifications. The 2030 Agenda, which places increasing demand for expanded data collection, is another critically determining element that countries need to take into consideration. This agenda is a plan of action for people, the planet and prosperity.

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[12] Ibid., para. 4.9.

1.35   Census planning needs to be guided by international standards and guidelines, such as the Fundamental Principles of Official Statistics,[13] as well as by national statistical legislation and the national statistical code of ethics. Population and housing censuses represent a unique opportunity to exercise leadership in promoting the use of statistics in overall development of societies, with the focus on improving service delivery and policy development.

1.36   The role of the national statistical office or statistical agency responsible for the census undertaking is to ensure a successful census programme that delivers results for use in evidence-based policy development, evaluation and research, and decision-making. Thus, statistical offices or statistical agencies responsible for census undertaking need to drive the following activities:

(a) Establishing statistical legislation that mandates the undertaking of a census;

(b) Setting policy and strategy by defining targeted outputs and outcomes for the programme;

(c) Strategic engagement with stakeholders by mobilizing participation across Government, business and the public at large;

(d) Raising the profile of statistical information and commitment to its use;

(e) Providing the opportunity to engage on key policy issues and strengthen relationships among information providers, policymakers and opinion leaders;

(f) Adhering to the Fundamental Principles of Official Statistics and ensuring that best practice is embedded in statistical procedures;

(g) Aligning with international standards and frameworks;

(h) Establishing statistical infrastructure and resources for undertaking the census;

(i) Setting up the census management project structure.[14]

1.37   Another set of international standards pertinent to conducting population and housing censuses – aside from the global *Principles and Recommendations for Population and Housing Censuses, Revision 3* and their regional variants[15] – is the Generic Statistical Business Process Model (GSBPM), Version 5.0.[16] The GSBPM describes and defines the set of business processes

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[13] Adopted by the Economic and Social Council of the United Nations in its resolution 2013/21 of 24 July 2013 and endorsed by the General Assembly of the United Nations in its resolution 68/261 of 29 January 2014.

[14] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 2.95.

[15] For the 2020 round of censuses, as was the case with the previous rounds, the Conference of European Statisticians, in cooperation with the Statistical Office of the European Union (Eurostat), prepared and adopted, in June 2015, the regional *Recommendations for the 2020 Censuses of Population and Housing*, fully in line with the global international standards, available at http://www.unece.org/fileadmin/DAM/stats/publications/2015/ECE_CES_41_WEB.pdf.

[16] Available at https://statswiki.unece.org/display/GSBPM/GSBPM+v5.0.

needed to produce official statistics. It provides a standard framework and harmonized terminology to help statistical organizations to modernize their statistical production processes, as well as to share methods and components. The GSBPM can also be used for integrating data and metadata standards, as a template for process documentation, for harmonizing statistical computing infrastructures, and to provide a framework for process quality assessment and improvement.

1.38   Taking into account the specifics of conducting population and housing censuses, the present handbook follows this overall business model, in terms of identifying phases, specifying needs, designing collection and outputs, building collection instruments, setting up and running collection, processing, analysing, disseminating and evaluating the overall process. Indeed, the outline of the handbook mirrors GSBPM levels 1 and 2 and, in addition, introduces elements that are of particular interest for population and housing censuses in all of the segments of preparing and administering a census, such as the role of geographical information systems (GIS) or the archiving and preservation of individual census records for the purpose of genealogical and anthropological research, to name a few.

II. Planning, organization and administration

A. Introduction

2.1   In the context of the overall planning for exercises within the national statistical system, census planning refers to the core process linking the different phases of the census cycle. While following the essential principles and guidelines for a statistical business process model, census planning still incorporates certain peculiar phases. Figure I presents an example of such an approach, displaying the links and relationship between major phases of the census cycle.

Figure I

Links among census phases

Note: the evaluation of the current census is an input for the next one.

Pre-enumeration operations, mapping, questionnaire design and testing

Evaluation, post-enumeration survey

Planning

Field enumeration

Dissemination

Analysis

Data processing
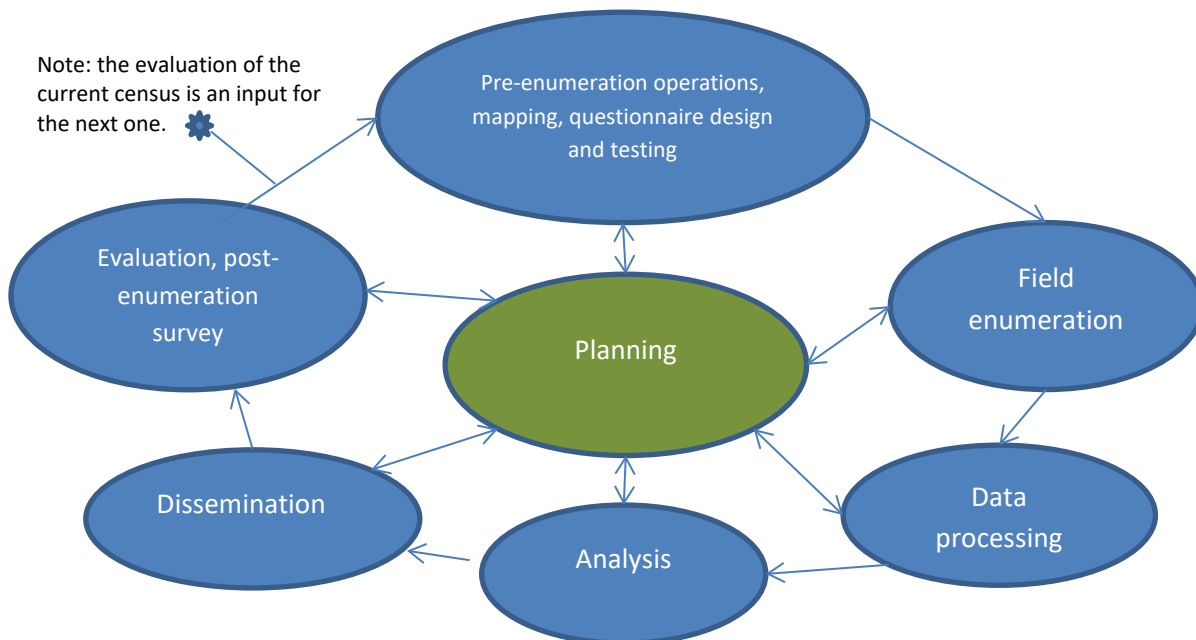
2.2   Planning can be regarded as the element of the census phases and processes that is most critical to the completion of a successful census. The focus in the early stages of planning will be on setting strategic directions for the entire census programme. As can be seen in the diagram, each phase of the census is dependent on a preceding phase. The quality of the output from each phase has a direct effect on the success of the next phase and other phases downstream.

2.3   In practice, it is likely (and desirable) that all phases interact with one another through a continuing process. For example, this occurs when the people undertaking the field enumeration phase observe something that will influence the interpretation of the output products and pass this knowledge to the dissemination phase team. This could also be regarded as the use of a "living plan" technique through which initial assumptions are continually updated throughout the census operation. This is particularly important in countries that are not in a position to conduct

censuses on a regular basis and may not have access to evaluation reports from the previous census.

B. Overall census planning

2.4   The aim of the planning process is to ensure not only that each phase is properly resourced and organized but also that the output of each phase is of sufficient quality for all subsequent phases, and that all dependencies between the different phases are identified. Because of the long duration of the census operation, planning should not remain static but should be flexible to take into account changes that occur.

2.5   When planning a census, there are a number of issues that require careful consideration. These are:

(a) Role of the Government;

(b) Stakeholder identification;

(c) Developing project plans;

(d) Monitoring project plans.

1. Role of the Government

2.6   There are three areas where the Government plays a role in a census. It provides the:

(a) Legal framework to conduct the census;

(b) Funding for the census;

(c) Logistic support for the census.

1.1   Legal framework

2.7   The population and housing census needs to be legally authorized. A specific agency, usually the national statistical office, has to be assigned with the legal authority for planning, organization and implementation of census operations. A comprehensive and well-timed legal framework is of utmost importance for ensuring the legality and authority for conducting the census itself. While the content of the census legislation varies considerably from country to country, it usually covers the following items:

(a) The authority of the census agency to undertake census activities;

(b) The roles of other organizations (especially other government ministries and national mapping agencies) in census taking;

(c) Obligations and rights of individuals when providing information, and of enumerators and supervisors;

(d) Provisions about confidentiality of information supplied by individuals;

(e) Funding of census operations;

(f) The basis of enumeration;

(g) Scope, method and timing of the census;

(h) Availability of administrative records that can support census operations.

2.8   It is advisable to have a permanent legal authority for taking periodical censuses. When required, amendments to legislation can be requested by the census authority. It is important to act early enough when changing census legislation so that census deadlines are not jeopardized. In any case, the legal framework needs to be clearly understood and incorporated into census planning. Due allowance should be made for the significant elapsed time that may be required for these legal processes. Section E below provides further information on census legislation.

1.2   Funding

2.9   In most countries, the Government provides specific funding for the census. The census is unlike many other activities of Government that receive continuous and relatively predictable allocations. The census budget is highly cyclical, with relatively low levels of spending through the preparatory and dissemination phases, and a large peak during the mapping, enumeration and processing phases. Governments need to be aware well in advance of when the peak expenditure is likely to occur so that it can be planned.

2.10   The cyclical nature of census costs requires that the census budgets are planned well in advance and cover all planned activities. Government agreement on the level of funding for the census is needed early in the cycle so that other aspects of census planning can proceed. Census managers will need to manage census funds and closely monitor the government commitment to the census to ensure that the agreed funds are actually available when needed. There have been many cases of Governments initially agreeing to a certain level of funding but eventually being unable to meet those commitments owing to other fiscal pressures. This can have disastrous effects on census planning. In some countries, other government ministries may provide funding for particular topics (for example, the labour ministry providing funding for labour force topics).

1.3   Logistic support

2.11   Many countries draw heavily upon other government agencies in the preparation and conduct of the census. This support may be provided either as part of the continuing work of these other agencies or may require the census agency to provide funding.

2.12   In many countries, teachers are used for enumeration. In these cases, it is vital that the census agency obtain the commitment and support of the minister of the appropriate government

agency responsible for teachers (for example, the department of education) and senior staff within that agency.

2.13   Where the support is provided as part of the work programme of the agency, census managers need to ensure that these other agencies are aware of the requirements of the census. These agencies should have appropriate plans and should have obtained the funding that will ensure that census goals can be met.

2.14   Some examples of other government agencies that may support census activities can include:

(a) Local or provincial governments, which may permit or encourage staff of their agencies to work on the census or provide infrastructure or services in regional centres;

(b) Local or provincial steering committees made up of staff from a variety of government agencies specifically set up to oversee census operations in their region;

(c) Other government agencies that supply specialist services such as form printing, mapping, transport services or media liaison.

2.   Stakeholder identification

2.15   The term "stakeholder" is used to describe a group of people or institutions who will be affected or have a stake in a specified activity. For the census, the most important stakeholders are current or potential users of the census data, most of whom will be external to the statistical agency carrying out the census, thus requiring the establishment of functioning two-way channels for exchanging opinions and suggestions. Given the broad scope of the census, its importance in planning and the need to involve a considerable proportion of the population to complete the census questionnaire, the community as a whole is also clearly a major stakeholder in the census.

2.1   Stakeholders within the census programme

2.16   The census operation in most countries involves the movement of the census questionnaire (or the data from it) through a series of phases, including field operations, processing, dissemination and evaluation. In this sense, each phase is a key stakeholder of the one preceding it, with dissemination being a stakeholder of data processing.

2.17   Identifying stakeholders is a useful starting point for determining critical dependencies when planning the census. Good and effective communication with these stakeholders is essential to ensure that each phase of the census meets the needs of the others and that the resources of the statistical agency are used most effectively.

2.18   The stakeholder relationship is not just linear (or circular, as described in the census cycle diagram in figure I), but also has consequential implications. For example, the following points

describe some of the potential stakeholders for the field operations phase. This is not exhaustive but illustrates how stakeholders may be identified.

(a) **Census evaluation.** The success of the census enumeration operation has a considerable impact on data quality, which is a prime concern of census evaluation. The census evaluation area is often responsible for analysis of census data to determine where data quality can be improved. This includes areas of the census form completed by census enumerators.

(b) **Census processing.** Census processing dependency on field operations is considerable. Some processing rules and procedures are partly determined by enumeration procedures and it is essential that good communication exist between the areas. Similarly, if electronic questionnaires are being used to enumerate, then processing requirements may have an impact on field routines.

(c) **Census data dissemination.** From a data quality point of view, census dissemination is dependent on the enumeration being complete and maintaining, if not improving, fundamental indicators such as underenumeration rates and response rates. Some census enumeration procedures may determine the nature and quality of particular data items.

2.19   Each phase also has internal stakeholders. For example, within the field operations phase, the packing and transport of materials into the field is a stakeholder of the printing process, while the recruitment of field staff is a stakeholder of the process for determining salary rates, and so on.

2.2   *Other stakeholders within the statistical agency*

2.20   In many countries the statistical agency will have regional offices spread throughout the country. In these cases the regional offices are key stakeholders as they play a vital role in supporting the field operations phase in their particular region.

2.21   Clearly there will be boundary issues, where some countries include all activities relating to the census within the census programme while others maintain separate units elsewhere within the statistical agency that perform functions on behalf of the census unit. If specialized skills exist in house, it is economical to use them rather than recruit separately for the census project. Examples of these functions could include:

(a) Statistical methodology (design of follow-up samples, advice on quality monitoring, sampling rates and so on);

(b) Information technology (IT) (evaluation of processing systems, hardware and software maintenance);

(c) Public relations (training and advice on public relations strategies and advertising campaigns).

2.22   There will also be stakeholders within the statistical agency who use the census results as part of their statistical operations. These could include:

(a) Statistical analysts preparing material by further analysis of the census results, including national accountants incorporating information on household income or housing stock into the national accounts;

(b) Client services, sales and marketing units identifying and satisfying external clients' needs;

(c) The area responsible for household surveys using census small-area counts to update sample frames;

(d) Other areas of the statistical agency, in particular the area responsible for intercensal population estimates.

2.3   *External stakeholders*

2.23   A key group of stakeholders are the end users of the census data. These can be either current users of census data or potential users of census data. The needs of this group define the concept of "relevance" that underlies all aspects of the census. Current users of census data may have well-articulated needs and generally are in a position to influence the directions of census taking. However, their requirements need to be monitored as to whether the topics continue to be needed or whether the census remains the most effective method of collecting the data. Quite often, users will request that particular topics continue to be included in the census, as they have built their planning models around these data items. However, there may well exist better sources for these data items than the census, or these data items may have ceased to have high social priority.

2.24   The census is a valuable resource that may be underutilized, and potential users are the hardest to engage in the census process. This cannot be achieved through a single campaign, as may be possible with current users. There is a need for a sustained education and communication effort to develop continuing understanding of the nature of decision-making and the need for census data to support those decisions. A range of tools such as meetings, seminars and publicity material about the census data can be used on an extended basis (see chap. III, sect. C).[17]

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[17] One of the most successful recent initiatives in bringing together stakeholders not only from different institutions but also from a whole continent during the 2010 census round is the example of the annual African Symposium on Statistical Development, spearheaded by Statistics South Africa and supported by the African Development Bank, the Economic Commission for Africa, the African Union Commission and the United Nations Population Fund, and

2.25   It is likely that many of the goods and services required by the statistical agency to undertake the census (including transport facilities, telecommunications, advertising, printing, cartography and specialized IT) will be acquired from outside the statistical agency. In some countries these may be supplied as core functions of another government agency, while in others the functions will be acquired from the open market. In either case, the organization that supplies this functionality is a stakeholder in the census.

2.4   Stakeholders outside the country

2.26   International donors are another important external stakeholder group who see census data as central to evidence-based decision-making. In many countries they may provide assistance, either through technical assistance to build the capacity of the statistical agency staff or through the provision of resources such as financial assistance, infrastructure, equipment, materials and vehicles.

2.27   Technical cooperation, including South–South cooperation, with foreign institutions having expertise in the use of new technology can greatly facilitate the decision to innovate, to introduce new technology, and to transfer skills and competences. Some countries have developed successful partnerships with others having expertise in the implementation of digital mapping, GIS, electronic questionnaires and other technology for data collection (see box 2). Such cooperation has been availed in the form of exchange of experience and best practices through study visits, dispatch of experts to render technical advice, training of census personnel, and loan or supply of equipment. The establishment of centres of excellence in developing regions of the world could promote the use of new technology, acquisition of equipment, training, and exchange of experience among national statistical offices, resulting in improved quality in census processes and data.

Box 2. Cooperation between Cabo Verde and Brazil in the use of new technology

The National Institute of Statistics of Cabo Verde (INECV), which conducted the fourth General Population and Housing Census of Cabo Verde in 2010, used the personal digital assistant (PDA) in an integrated manner for the mapping and data collection phases of the census. To achieve these objectives, the Brazilian Institute of Geography and Statistics (IBGE), which has an established expertise in the use of the PDA, was a key partner in strengthening INECV staff capacity through technical assistance missions and technical study visits. This partnership allowed INECV staff to develop a digital census mapping system using GIS technology and applications to collect and extract the data. Moreover, Brazil loaned part of the PDAs used by Cabo Verde. This partnership allowed Cabo Verde to pioneer the use of PDAs in a population census in the continent of Africa. Through this assistance, Cabo Verde acquired technical capacity that enabled it to develop applications for

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dedicated to strengthening national capacities in conducting and utilizing the population and housing censuses in Africa.

surfaces implemented after the census and to give technical assistance to Senegal in 2013 for its General Population, Housing, Agriculture and Livestock Census. Furthermore, INECV received study visits from a number of countries, including Burkina Faso, Ethiopia, Madagascar, Mauritania, Niger, Togo and Tunisia.

Source: Instituto Nacional de Estatística, Cabo Verde.

2.5   The community

2.28   The community at large may be expected to have only an occasional interest in the census that generally peaks around the time the census is carried out, or when initial data from the census are released. Public communication activities that focus on the benefits of the census at the time of census enumeration and those that provide for wide publicity of significant results at data release are ways of engaging public interest.

2.29   While the community at large does not have a direct input into the planning of the census, the need for continued cooperation of the public should be kept in mind throughout the process. Key areas of public concern are around the issues of confidentiality and privacy, the sensitivity of particular questions, and the amount of time required to supply the information on the census form or to the census enumerator. Countries may choose to encourage the community to engage with aspects of the planning process, for example during consultation on census content, to increase understanding of the benefits of the census and help to ensure public acceptability of plans.

2.30   Ideally, the confidentiality of information provided on the census by individuals will be protected by law. Census records should only be used for statistical purposes and not for general administration. This means that other government agencies should not be able to access individual census records and that the records are protected from scrutiny by courts or other judicial processes.

2.31   Questions on the census must be publicly justifiable and not be too intrusive. People may be reluctant to provide reliable answers or to provide answers at all if there is no perceived benefit. The same situation applies for intrusive questions.

3.   Developing project plans

2.32   Once the objectives have been established and strategies identified to implement them, more detailed planning begins. Undertaking a census is usually regarded as a single project comprising a series of project phases.[18] Each phase is further broken down into appropriate

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[18] Generic Statistical Business Process Model (GSBPM), Version 5.0, describes the possible steps in the statistical business process, comprising three levels: level 0, the statistical business process; level 1, the phases of the statistical business process; and level 2, the subprocesses within each phase. This approach is applied in the design of a census

activities, and similarly each activity is broken down into various tasks. However, in view of the size and complexity of the census operation, it can be divided into a series of related projects that are dependent on one another – for example, mapping and data processing can be considered as a subproject, considering the specialized work required in terms of skills, technology and methodology used.

2.33   To achieve appropriate design of the census project a simple hierarchical framework needs to be developed, similar to models that can be found in most project management texts or software. For the purpose of this handbook, the following basic structure and definitions are used:

(a) **Project.** Population and housing census (the statistical business process).[19]

(b) **Phases.** The major components of the project needed to achieve specific objectives. Phases are typically sequential, where the prior phase is essentially complete before the beginning of the next phase (though they can occasionally overlap).

(c) **Activities**. Higher levels of work covering the series of tasks defined for each phase.

(d) **Tasks.** The smallest identifiable amounts of work leading to a deliverable. Time, cost and resources can be assigned at the task level.

(e) **Milestones.** Specific points in time at which key outcomes are expected and which measure a project's progress.[20]

(f) Issues that need to be taken into account in project planning.

(g) Risk management.

2.34   Given the basic framework, the job becomes one of identifying each level, starting at the top and working down. It will often take a number of iterations to get it right. For example, something may be identified initially as a task but may become an activity phase after the project is considered in more detail, or because it increases in priority or complexity once the project plans become clearer. More often than not, the original project plan will change owing to unforeseen circumstances.

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project taking into account its key characteristic as a complicated and extensive statistical operation consisting of a complex series of interrelated steps.

[19] While the project itself is not a component part of the generic statistical business model, it is used here to indicate the highest hierarchical level and a starting point.

[20] All the items of the structure presented here need to incorporate risk management as one of the critical dimensions.

2.35   As the levels in the framework are filled with detail, responsibilities can be assigned and reporting and review arrangements established. Assigning responsibility in this way is the first step in giving staff ownership of the process.

2.36   There is no single approach for determining phases of the census project. However, in general, the census covers the following phases: planning; preparation; promotion or publicity; mapping; questionnaire development; enumeration; data processing; analysis and dissemination; and evaluation (table 1). Identifying and scheduling the various phases of the total census cycle provide the basis for planning. Initially, this should be done at the highest level of the census cycle. It should then be further developed into the different activities that make up each of these phases. These activities can then be further broken down into tasks to establish resource estimates and responsibilities, and confirm the dependency and timing of interrelated tasks.

3.1   Phases

Table 1

Census phases

No.	Phase	Includes
1	Planning	Setting strategic objectives for the entire census programme and developing project plans
2	Preparation	Establishing the basis of enumeration, technical committee formation, consultation with users, contracting out, publicity strategies, and finalization of administrative geographical units
3	Publicity	Publicity campaign, developing promotional instruments, implementation strategies
4	Mapping	Decision on technology and method, gathering point data, satellite imagery, carving out enumeration areas, recruiting GIS staff, creating a GIS database, verification
5	Questionnaire development	Selection of topics, form design and testing
6	Enumeration	Recruiting and training field staff, public relations campaigns, carving out enumeration areas, field enumeration, form distribution and return
7	Data processing	Recruiting and training data processors, selecting and managing premises, testing data entry solutions, processing forms

No.	Phase	Includes
8	Analysis and dissemination	User consultation, product development, preparation of thematic reports, utilization, promotion of census products
9	Evaluation	All evaluation plans and processes

3.2   Activities

2.37   Once phases have been identified and agreed, the next step is to break down each phase into component activities. This is a similar process to identifying phases but begins to focus on more detail. Fewer staff would be involved and there would be more consideration of issues such as timing, resources, stakeholders and outputs.

2.38   The activities include usually a series of tasks related to designing, testing and producing outputs. As an example, questionnaire development can be broken down into several activities depending on method of enumeration and technology used. In general, it includes the tasks related to communication with users, drafting the census questionnaire and instructions, testing the questionnaire, and finalization of the questionnaire content and design.

2.39   Once the activities have been identified and agreed, a staff member is assigned overall responsibility for each activity. One person may be responsible for several major activities – the important point being that each major activity is represented within the census management structure.

2.40   Also at this point, it is useful to establish the broad time frame of each activity. This helps to clarify the relationships between the activities, and also provides guidance when identifying and scheduling tasks. Furthermore, interdependencies between certain activities will determine the actual schedule of activities.

2.41   Identified milestones (see subsection 3.4 below) are useful in establishing the end dates for each activity. For example, if it is known that printing must be completed by a certain date to allow sufficient time for materials to be distributed, then that date would become the end date for the printing activity, as shown in table 2.

2.42   Phases do overlap and so start and finish dates at this level will also overlap. Techniques such as simple flow chart diagrams should be used to chart phases and identify dependencies. These techniques are preferred rather than adopting more complex project management techniques such as network analysis, since the overhead in maintaining and managing such networks can be extremely high.

Table 2

Example of an enumeration phase

No.	Activities	Includes
6.1	Developing methods and procedures for carrying out field enumeration	Development of all enumeration and administrative procedures, including determining how enumerators and supervisors will conduct the census
6.2	Testing methods and procedures (including pilot census)	Development and implementation of all tests regarding the field organization and implementation. As a major activity, this brings together all aspects of the enumeration, on a small scale, and can act effectively as a quality assurance measure on the operation in addition to the specific goals of each test
6.3	Regional and local census committees	Census committees are established in the field to carry out the fieldwork
6.4	Recruitment and payment of temporary field staff	Development of procedures for the recruitment and payment, including job advertisement, selection, hiring, performance evaluation and payments
6.5	Training of the field staff	Development of training materials and agenda and timetables for training of each level of the field staff
6.6	Management and information system	Design of the system, developing application, testing, training of field staff, management and information system reports and evaluations
6.7	Printing census materials	Development of specifications and contracts to acquire all materials to be used in the field. Prime example is the printing of the census form. Includes printing of manuals, training and publicity materials
6.8	Distribution and return of census materials, data transmission[21]	Development of strategies, contracting out, distribution and collection of materials, monitoring and reporting system
6.9	Evaluation, documentation and archiving	All evaluation plans and processes and documenting lessons learned

3.3   Tasks

2.43   The last step is to identify specific tasks. Tasks describe what needs to be accomplished in the project. This is the actual work to be done by the team. By this stage many tasks will have been identified as a result of developing phases and activities, and it is now a case of inserting the tasks into the appropriate activity. However, it is still useful to go through a process similar

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[21] In a number of countries, the use of handheld electronic devices for data collection requires setting detailed protocols and deadlines for electronic data transmission from the field to the census office.

to that undertaken with phases and activities to ensure that every possible task is identified at this stage, and does not come as a surprise further down the track.

2.44   Using the same example developed above, table 3 shows the tasks that may be identified for the activity "distribution and return of census materials" in the phase of enumeration.

2.45   The list in table 3 is not exhaustive but is used to illustrate the idea of breaking down activities into tasks. Responsibility for each task would be assigned, and items such as start and finish dates, resources and outputs (for example, a manual or computer process) would be identified.

2.46   Identifying and scheduling tasks (that is, filling the framework with detail) cannot be done in an ad hoc manner. There needs to be a planning process to ensure that all tasks are identified in an orderly way and consistent with the overall management of the census operation. The use of a framework such as the one described above provides a methodical basis for this objective.

2.47   As mentioned above, each phase, activity and task would have someone responsible for it. However, there is also a need for coordination and communication between the various activities, and this is where identifying and scheduling tasks is linked with the census management structure (see section D of the present chapter). The census management team needs to agree on how progress will be reported for each of the major activities and to what level of detail for the various steering or planning committees that have been established to provide advice on aspects of census management.

2.48   At the phase and task levels, project leaders need to ensure that their dependencies and successors are known and liaison established. For example, it does no good to have clearly identified and scheduled the distribution and return tasks above if the production of census materials will be too late for distribution to the field.

Table 3

Example of a list of tasks for the distribution and return of census materials

Activity	Tasks
Distribution and return of census materials	Review previous census methods for the distribution and return, procedures, materials and outcomes
	Develop a strategy for distribution and return of census materials (including outsourcing) taking into account types of census materials, volume and final destination of delivery
	Prepare the specifications for packing and transporting the materials on the basis of method of delivery and time schedule and responsibilities of partners
	Establish mechanisms for monitoring, evaluation and documentation of procedures and processes
	Test planned tasks
	Finalize all procedures and processes
	Implement and monitor the fieldwork
	Evaluate and prepare a report for all processes; assess weaknesses and success of the operation and make suggestions for the next census

3.4   Milestones

2.49   A milestone is a point in time that identifies when a significant point of the project should be reached. Milestones can be identified in any part of the project, though they are generally associated with the completion of a set of project deliverables. Completion of all the tasks in an activity may be considered a milestone, or the completion of an entire phase. The use of milestones provides focal dates for the project team and helps in monitoring progress of the census.

2.50   In a reference to census management, there are two most common ways of determining a milestone:

(a) Create it as a single-day task to be used as marker on the census schedule indicating that a certain objective is achieved, for example the date for the final census questionnaire, or the date for starting the distribution of census materials;

(b) Create it as a parent task containing all other subtasks that are required to complete a certain objective, for example determining the method for enumeration or data processing.

3.5 *Issues that need to be taken into account in project planning*

2.51   There are issues associated with each activity and task that need to be taken into account in project planning. Obvious issues are timing and resources. Less obvious issues include risk management and goals. As part of the planning process, it is useful to identify the issues associated with activities and adopt a consistent approach in listing them for all activities. Different project management approaches will offer different ways of achieving this objective.

2.52   One method is to use an issues table, one of which is prepared for each activity. The issues table simply lists a number of generic issues that activity leaders consider against their activities. The purpose of this table is to ensure that issues such as evaluation and testing are not forgotten and to provide a basic and uniform set of information about the project, available to all staff.

2.53   Table 4 is a sample issues table with descriptions of the type of information that might be recorded. The right-hand column is presented as a list of questions that a typical project leader might ask about a particular issue as it relates to the project. The table may be a simple form on paper or on a spreadsheet. In some cases the information for each issue may be recorded in the table itself, or the table may simply be used to tell readers where the information about that issue may be found. It is flexible.

2.54   Completing an activity issues table for each activity is a one-time exercise. A complete set of activity issues acts as a ready reference for the entire operation, as well as an index to where more detailed information can be found.

Table 4

Examples of activity issues

No.	Item name	Description	Questions
1	Overview	Describe enough background to the activity for people to understand where it fits in.	How would I describe this activity to someone in two or three sentences?
2	Approval	Note if there has been, or should be, any formal approval for this activity	Does this activity need to be approved by anyone?

No.	Item name	Description	Questions
3	Goals and objectives	Describe the goals of the activity	What is the purpose of the activity? Why do it? How does this activity add value?
4	Deliverables	Describe the outcome of the activity. This may be a specification document, a manual, a computer system, or other deliverable	What is actually produced by this activity?
5	Schedule, dates	Start and finish dates as well as any key dates along the way. This may simply be a file that progress is shown in or it may be a separate document	What do people need to know about the timing or scheduling of this activity? Are there any critical dates involved?
6	Stakeholders	The people or organizations, including outside the agency, who are important to this activity. They may be dependent on this activity or vice versa	Who would I need to involve in planning, developing or implementing this activity? Who is the client?
7	Dependencies	Process relationships – the activities or tasks, including other areas, that depend on this activity or vice versa	What inputs do I need? Where do the outputs of this activity go?
8	Key tasks	Describe the key tasks that make up this activity	What tasks have to be done for the activity to be completed?
9	Risks	Describe the potential risks, their likelihood and contingency plans	What can go wrong and how likely is it? What are the critical success factors?
10	Specifications	These may be technical specifications, such as an IT application or a description of what is involved in this activity. This will depend very much on the nature of the activity	What do I have to specify in order for the activity to get done? What would I have to tell someone about how to go about it?
11	Resources	Staffing, budgets, costs, etc. Staffing costs refer to people working on the activity and do not have to be exact	How much is this activity costing in terms of people and money?
12	Training	Training that may be required to enable this activity to be done	What skills would someone need to do this activity? For example, competence in use of computer software, acceptance testing, negotiation and procurement

No.	Item name	Description	Questions
13	Performance measures	The performance measures against which the success of this activity will be measured	How will I know if this activity has been successful?
14	Management information	Information that can be extracted from the activity to inform people about progress, and also to provide data for analysis (such as number of people paid, number of urban enumeration areas)	What information from this activity will help people to know how things are going or assist in analysing the activity later?
15	Testing	The testing plan for the activity	How will I test this activity to be confident that it will work or that the right outcomes will be achieved?
16	Evaluation	The evaluation plan for the activity	How will this activity be evaluated? How will other items in this table contribute to the evaluation? How has previous feedback been dealt with?
17	Reporting	Information about the level and detail for reporting on this activity; name and location of relevant project management software file	What do I have to report, and how often, so that people know the status of this activity?
18	Documentation	Describe what documentation exists about this activity. This may be other items in the table, such as specifications	What would I tell someone who wanted to learn about this activity to read?
19	Archiving	Describe archiving procedures and protocols for retrieval	How are the records archived? Where are the census documents and how are they retrieved?
20	Service agreement	Details of any service agreement associated with this activity	If other persons are doing some work on this activity for me, what agreement should I have in place with them?
21	Closure	How the activity is closed; what occurs when the activity is finished	How do I know when this activity is finished? Who needs to be told?

3.6   Risk management

2.55   In general, risk management refers to the identification and assessment of risks, followed by the development of actions aimed at mitigating the impact of undesired outcomes or reducing the probability of those outcomes happening. Risks have various sources; in principle, they can

originate in accidents or natural causes – both unpredictable – or in insufficient or inadequate, thus preventable, human-generated incidents. For example, inadequate training of enumerators increases the risks of having poor-quality statistics. In the case of the population census, given its complexity, risks are omnipresent and the risk management acquires an even more substantial dimension. Assessing the risks is addressed throughout the present handbook when elaborating separate phases and activities; here, essential points related to planning for risk management are presented.

2.56   Risks are events that could occur and in some way have a negative impact on the success of the census. An example of a risk event may be that sufficient enumerators for a particular geographical area cannot be recruited. These events might not occur at all, but nevertheless risks with significant likelihood should be managed explicitly by developing fully detailed plans to mitigate the consequences of these events and to set up alternative ways forward. There may be more than one parallel plan for a particular risk, depending on possible times of risk actualization.

2.57   To be effective, risk management must be an integral part of the project management. In the case of the population census, risk management refers to the identification, analysis, mitigation and reassessment of risks throughout the census phases. It also includes developing and instituting contingency plans should a risk become an issue. Implementing risk management in censuses:

(a) Fosters early identification of strategies to reduce or eliminate the potential impact of known risks;

(b) Provides a structure for monitoring and documenting changes in risk assessment and for managing the response to those changes;

(c) Identifies areas where further study or analysis could potentially lower future risk;

(d) Facilitates integration of operations or systems through early identification and resolution of risk that cuts across activities.

2.58   An important part of risk management is the continual reassessment of the activities or project to evaluate how risks may have changed and to identify new risks. For maximum effectiveness, risk management must be performed using a common, systematic and repeatable approach so that risks can be identified, managed and unambiguously communicated to managers and stakeholders.

2.59   Risk management is essential because of the importance of the census and the fact that it is an infrequent exercise. The success or failure of the census may depend on the implementation of the plans associated with these risks if they eventuate.

4.   Monitoring project plans

2.60   Monitoring the census project plans as described above and managing the information flows are important parts of census planning. It is imperative that the overall project plan is monitored closely and that appropriate feedback is delivered to all levels of management. More often than not, the original project plan will change owing to unforeseen circumstances (for example, delays in arrival of equipment or technical difficulties) or the identification of additional tasks. It is therefore important that there be a feedback loop that compares actual results with the plan, and assesses the impact of any deviations from target dates and costs. It is very important that these feedback mechanisms be based on good communication practices.

2.61   The results should be reviewed on a regular basis, remembering that if these reviews are done too frequently the overhead increases. However, if done too infrequently, corrective actions may not be taken promptly enough.

2.62   As stated above, the project plans comprise phases, activities, tasks and milestones. The most important components to track are:

(a) The calendar time for completing a task;

(b) Resource usage per task;

(c) Cost per task;

(d) Milestones met.

2.63   As there is always interdependency of individual tasks, instruments designed for tracking need to allow for such a display. This can be done using a Gantt chart that graphically displays schedule-related information. In the typical Gantt chart, activities or other project elements are listed down the left side of the chart, dates are shown across the top and activity durations are shown as date-placed horizontal bars. An example is shown in figure II. There are a variety of off-the-shelf software packages that can be used to produce Gantt charts.

2.64   For a more descriptive example of a census project Gantt chart, which details all the relevant steps that can be taken to ensure the effective monitoring of the census project, see annex I.

Figure II

Gantt chart of integrated schedule for the tests, key milestones and production operations of the 2020 census in the United States
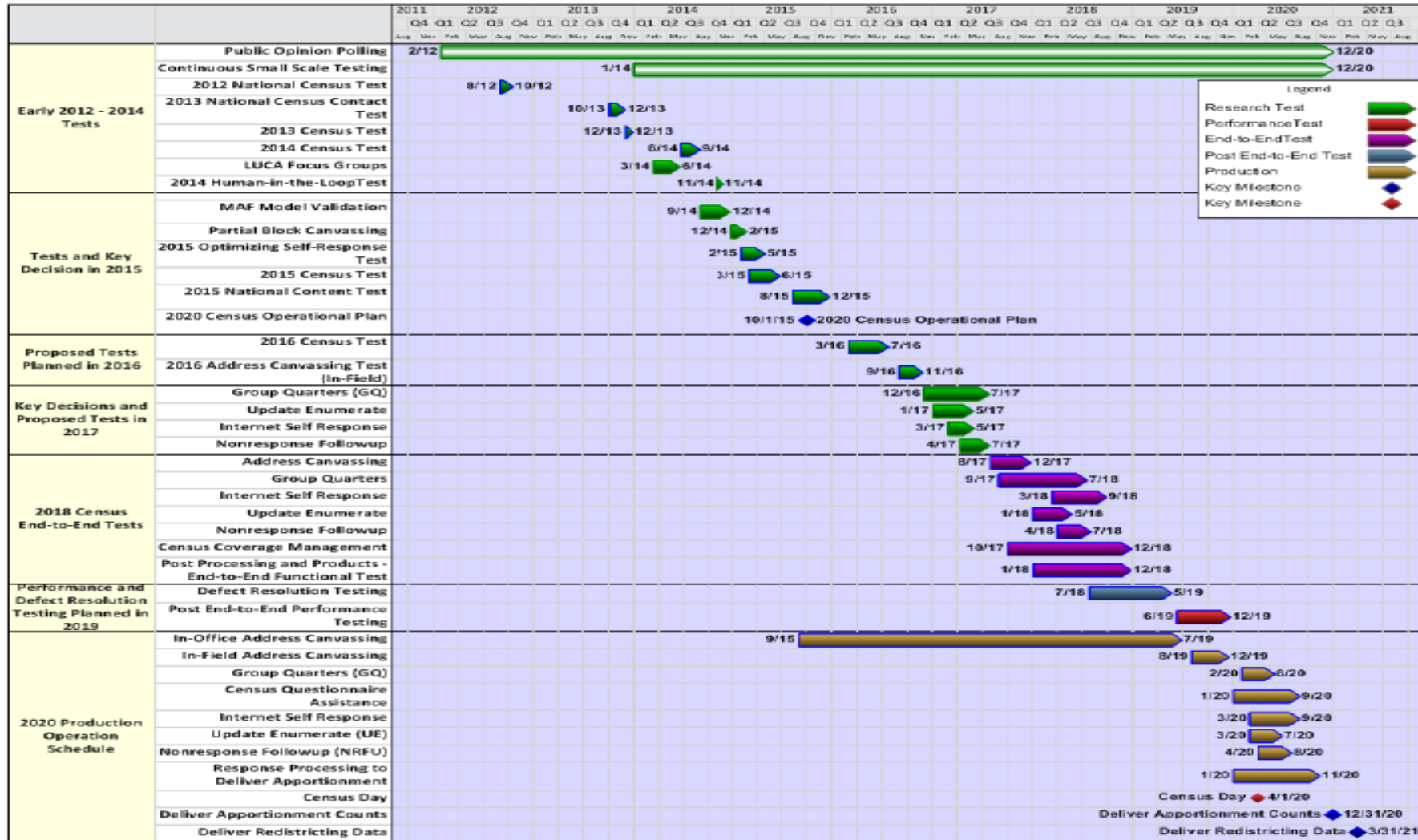
Source: 2020 Census Operational Plan, United States Census Bureau, 2015.

4.1   *What to review*

(a)   Status information

2.65   Status information is typically recorded at periodic meetings attended by all key project participants. The information normally includes status of tasks, status of important milestones, progress, and actual start and end dates.

(b)   Analysis of variations

2.66   After recording status information, the impact of any deviations on project schedule, cost and resources should be analysed. In particular, special attention should be given to:

  (a) Slippage of critical tasks leading up to milestones;

  (b) Overcommitment of resources in the remainder of the project;

  (c) The "99 per cent complete" syndrome – managers must be able to realistically estimate time to 100 per cent completion;

  (d) Rescheduling – if it is estimated that the completion date of a task cannot be met, then the task must be extended on the Gantt chart and in other documentation. This must be a highly visible process, with rescheduled tasks clearly identified in the Gantt chart. Originally expected completion dates should remain on the chart.

4.2   *What to report and to whom*

2.67   The Gantt chart, which is generally a clear means of communication, can be used as the main reporting vehicle. Different levels of management will require differing amounts of detail on project plans. A generic management structure is shown in section D of the present chapter. Listed below are some of the levels outlined in that section and the amounts of detail on project plans they may require.

(a)   Project team

2.68   The project team is responsible for the completion of project tasks at the agreed timetable and acceptable levels of quality. Therefore, the team will need reports in the finest detail that show the progress of each individual task. The project team should agree on what needs to be monitored and the frequency of reviews that should be conducted through regular meetings. These regular meetings can provide a formal mechanism through which reviews are conducted. However, it is important that the project team not rely solely on these meetings to monitor progress. Maintaining regular contact and open communication channels in their day-to-day activities with all stakeholders in their own project team, and other dependent project teams, is critical to successful project monitoring.

(b)   Project manager

2.69   Project managers are ultimately responsible for all tasks defined in the project plans and are accountable for delivering target outcomes and meeting the project budget and delivery schedule. Therefore, they will need reports at all levels of the project plans (phase,

activity and task). They will generally use reports at the phase and activity level for their day-to-day management of the project but they should also be able to get down to the task level if necessary.

(c)   Executive officer

2.70   One of the roles of the executive officers is to oversee the programme through the generation of target outcomes. Therefore they may only be interested in data at a level higher than task or activity and only require concise status reports that answer the questions "Are we ahead or behind schedule? By how much?" The executive officers require clear, succinct information showing just where the project stands and what actions, if any, are required of them.

C.   Plans for enumeration

1.   Introduction

2.71   A population and housing census is a most complicated and extensive statistical operation, consisting of a complex series of interrelated processes. For planning census activities, the first consideration is to determine the key census goals and the basis of the enumeration. This provides a framework for proceeding with more detailed planning for field operations.

2.72   The present section explores the basic issues that should be taken into consideration before planning the field operations.

2.   Key goals

2.73   Initial planning for a census will have established broad goals for the census programme as a whole (see also section B of the present chapter). The following is a list of some broad topics for consideration as goals for the census enumeration. It is not an exhaustive list and some topics may not be applicable in some countries.

(a) **Full coverage.** Census enumeration procedures need to be designed to ensure that full coverage of the population is achieved, while adhering to budget and timetable considerations.

(b) **Confidentiality.** Procedures should be designed to ensure confidentiality of census data. The confidentiality requirement encompasses the whole census operation, ranging from the security of the completed census questionnaires both in the field and during processing to the protection of the information contained in the outputs and made publicly available. Examples of measures that should be taken to ensure confidentiality include enumerators wearing identification passes; privacy envelopes being provided for people who request them; and names and addresses not being included in the databases intended for public use and dissemination.

(c) **Census publicity**. The goal is to have the public well informed about the need for, importance of, and benefits of a census. Thus, emphasis should be placed on key aspects such as the benefit of the census to the community and confidentiality and privacy. A good public relations campaign will also contribute to response rates and data quality.

(d) **Compliance**. Minimizing non-compliance should be considered a key goal of the census enumeration. Enumeration manuals and training should provide specific guidance on how to address non-compliance issues during enumeration.

(e) **Cost-effectiveness.** All enumeration processes and procedures should be developed with a view to maximizing cost-effectiveness.

(f) **Recruitment and training of field staff.** An important goal for census enumeration should be the establishment of the most efficient procedures and processes to recruit and train high-quality field staff.

(g) **Accountability.** All materials should be accounted for. This can be reflected in a goal that all census forms or tablets are received at the processing centres and that there are no reports of lost census materials in the field.

(h) **Availability of materials.** This includes availability of instruments (such as maps) necessary for enumeration.

(i) **Involvement of key representatives.** Involvement and cooperation of local leaders will assist community acceptance of the census.

(j) **Consistency of procedures.** Procedures should be consistent across all regions within the country.

(k) **Special enumeration.** In some countries, the enumeration of particular subgroups of the population can be more physically, culturally or politically difficult than that of the mainstream population. Where subgroups are identified for special enumeration, a goal could be to ensure that procedures are in place and special strategies devised to ensure their inclusion in the census.

(l) **International comparability**. The national census methodology needs to be harmonized and in compliance with international statistical standards in terms of essential definitions and classifications, as well as dissemination guidelines.

(m) **Documenting census experience**. Keeping meticulous records of all activities and processes will not only provide transparent information regarding the overall operation of the census but will also allow for developing ways of planning for increased efficiency in the next census.

(n) **Security of field staff**. The personal safety of field staff is of paramount importance in most countries given the remoteness of, and hazards that exist in, certain areas.

2.74   There are many other potential goals that may apply to particular countries. During the planning phase of the enumeration, the important question to ask is, "What outcomes are we aiming at as a result of the enumeration?" The outcomes could be expressed as rates or absolute numbers. For example:

(a) A gross undercount rate of x per cent or less;

(b) A cost per capita of y units of currency;

(c) Reduction in underenumeration of x per cent relative to the previous census;

(d) Reducing the non-response of x per cent relative to the previous census.

3.   Basis of enumeration

3.1   Concepts of enumeration

2.75   Describing the total population of a country and its geographical distribution within the country are common and essential elements of all censuses. However, the definition of what constitutes the population of an area varies from country to country and largely depends on the requirements of users. The total population may be defined to include or exclude foreigners in the country and its own nationals in other countries. It may or may not include certain population groups within the country.

2.76   While the definitions of total population vary among countries, those definitions are nevertheless categorized under either of the two principal concepts commonly adopted for a census enumeration, namely:

(a) Place where the person is present (de facto);

(b) Place of usual residence.

2.77   Enumeration of each person either where the person is present or the person's usual residence will be used as basis for an accurate count of the population of a country at a point in time.[22] It is essential that the same principle for enumeration be adopted across the entire country.

(a)   Place where the person is present

2.78   This category includes all persons physically found present in a country on the date or time of the census. The enumerated population will comprise all persons present in the country when the census is taken and enumerated at the place where they are at census night, regardless of their usual place of residence. In practice, and for operational convenience, the concept is applied to the place where the person slept on the night preceding census day or was present at a defined census hour (usually midnight of the census day). See chapter IV, section B, for more elaboration.

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[22] Definitions of "population count", "population present" and "usual resident population" are provided in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 4.22–4.43.

(b)   Place of usual residence

2.79   This includes all usual residents. In general, "usual residence" is defined for census purposes as the place at which the person lives at the time of the census, and has been there for some time or intends to stay there for some time. Most individuals enumerated have not moved for some time and thus defining their place of usual residence is unambiguous. For others, the application of the definition can lead to many interpretations, in particular if the person has moved often.

2.80   As stated in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, it is recommended that countries apply a threshold of 12 months when considering place of usual residence according to one of the following two criteria:

(a) The place at which the person has lived continuously for most of the last 12 months (that is, for at least six months and one day), not including temporary absences for holidays or work assignments, or intends to live for at least six months;

(b) The place at which the person has lived continuously for at least the last 12 months, not including temporary absences for holidays or work assignments, or intends to live for at least 12 months.

2.81   With this method, all persons present at their place of usual residence at the census time will be enumerated, as well as those who may be temporarily absent from their place of usual residence, irrespective of where they are at the time of the census. See chapter IV, section B, for detailed elaboration.

(c)   obtaining both the place where the person is present and the place of usual residence

2.82   Countries may enumerate population using both approaches for producing a population count for usual resident population and population present. In this approach, people are enumerated considering both the place of usual residence and the place where they are present at the time of the census. Special care should be taken to avoid potential problems with double counting of population. In order to produce populations based on these two places, it is necessary to collect data for each individual to distinguish their status as follows: (a) persons who are usual residents and present at the time of the census; (b) persons who are usual residents but not present at the time of the census; and (c) persons who are not usual residents but present (visitors) at the time of the census. Thus, a population present (de facto) count will consist of items (a) and (c), while a usual resident population count will consist of (a) and (b).

3.2   Units of enumeration

2.83   Individual enumeration is one of the essential features of a population and housing census. The units of enumeration are thus identified at very early stage for planning census operations particularly related to enumeration and dissemination.

2.84   In the population census, the primary unit of enumeration is the person. There are two main frameworks for identifying persons: (a) households[23] and (b) institutions as a subset of collective living quarters,[24] in which most persons are identified.

2.85   For the housing census, there are three units of enumeration: (a) households, (b) living quarters and (c) buildings. These three units are clearly distinguishable in conceptual terms.[25]

2.86   Units of enumeration for population and housing census should be defined according to the objectives of the census, and clear definitions of these units should be given in the manual of instruction for the enumeration.

3.3   Method of enumeration

2.87   There are two main methods of enumeration: face-to-face interview (or enumerator) method, and self-enumeration method. A combination of the two methods can also be used in one census. Further information on the method of enumeration is provided in chapter IV, section B.

2.88   The use of new technology during the field enumeration has introduced substantial changes in application of methods of enumeration. The traditional method of enumerating the population through face-to-face interview can be applied in different ways, using a paper questionnaire or handheld devices to automatically capture data. The self-enumeration method also can be applied using different techniques, for example a paper questionnaire or the Internet. A combination of methods using different types of technology can also be used for enumeration.

2.89   The decision regarding the method of enumeration and technology – if it is applied – should be taken in the early stages of census planning, because of the wide-ranging implications of that decision. In contemporary censuses another factor that is increasingly influencing the method of enumeration and the technological solutions adopted is the existence and availability of a reliable national address frame. Consideration of the method of enumeration will take into account its impact on the following:

    (a) Budget;

    (b) Organizational structure of the census;

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[23] Included in this category are homeless people as, under the definition of "household", a homeless person is identified as a "single-person household". The framework described here does not refer to the physical structures, that is, "household" does not refer to a household dwelling; rather, it refers to the social construct of a household, irrespective of its place of abode.

[24] Although most people live in housing units and institutions, there are other types of places in which people can be enumerated, such as hotels, rooming houses, camps and workers' quarters, military camps, workers' camps, or refugee camps. Detailed explanations and classifications of living quarters are given in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paragraphs 4.421 to 4.462.

[25] Definitions of "households", "living quarters" and "buildings" are provided in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 2.33–2.45.

(c) Type of questionnaire and its content and design;

(d) Selection of field staff;

(e) Training programme;

(f) Content and scope of publicity campaign;

(g) System of management of records.

4.   Potential constraints

2.90   Establishing the basis of the census enumeration should also take into account major constraints. These are factors that are effectively unchangeable or outside the direct control of the statistical agency but will influence the planning or carrying out of the enumeration. The value in identifying these constraints is that the risks associated with them can be identified and appropriate risk management guidelines developed. Failure to identify major constraints early may result in a negative impact on the census enumeration at a time when there is little or no scope to react or where the cost may be prohibitive. Major constraints may include the following.

(a) **Budget.** While careful consideration is given to the census budget, emerging issues may result in unexpected shortfalls. Given the cyclical nature of and fiscal funding peaks required for a census, it is generally difficult to obtain extra government funding if there is a shortfall. In addition, economic efficiency by the Government of the day can place funds already approved under review.

(b) **Government or other authority decisions.** For example, the Government may direct that a census be held in a certain month or that a particular subgroup of the population be given special treatment.

(c) **Production capacity**. This applies in particular to producing maps, printing the census questionnaire, and the collection of data with handheld electronic devices and related procedural documentation. The scale and specialized nature of these tasks may require technology beyond that readily available in some countries. In some cases, it may be highly undesirable to undertake this work outside the country owing to loss of control and quality assurance considerations.

(d) **Logistic capacity**. This refers primarily to the bulk movement of materials (such as questionnaires, manuals and tablets) into the field and their return to the processing centres. It requires sufficient infrastructure (for example, roads and railways) and transport facilities (trucks, cars, boats and possibly aircraft) to allow one of the major logistic challenges of modern society to operate smoothly. For countries using handheld electronic devices for census enumeration a number of technical constraints also need to be addressed related to the availability of networks to ensure the transmission of records from the field.

(e) **Coincidence of other national activities**. For example, in some countries an election may be scheduled in a census year, which may have an impact on the ability to obtain a sufficient number of enumerators. This is also a planning issue in countries where an election or other national activity may be called well into the planning of the census enumeration.

(f) **Environmental factors**. Seasonal weather patterns, for example, may make enumeration difficult in parts of the country.

(g) **Security**. The safety and well-being of enumerators may be difficult to guarantee in some areas, such as areas of civil unrest.

(h) **Public opinion and attitude.** If the mass of public opinion is not favourably disposed to the census operation, it will usually fail or be very expensive. Counting people in the information age requires effective communication with households not only to encourage participation, but also to ensure the correct messages are delivered regarding the count and to gauge public attitudes, which can be resistant to or negative towards a census. The existence of hard-to-count groups can lead to undercounting, compromising the quality and reliability of the census result.

(i) **Technical capacity.** The introduction of devices and other technological advancements will require reskilling of existing staff used to paper-based methods. A dependency on consultants to avoid this in countries with limited expertise is a possible risk, and an emphasis on skills transfer should be mandatory in service provider agreements. A new requirement for national statistical agencies is now not just methodological expertise but also capacity in ICT and competence in managing innovation.

2.91   The purpose of identifying major constraints when establishing the basis of enumeration is not to solve any associated problems, but rather to take them into account in subsequent planning.

D.   Administrative organization and management structure

2.92   The combination of two factors makes managing a census challenging. First, it is often the largest peacetime project that a country undertakes. Second, it does this only periodically, usually once every 10 years. Thus, managing a census project entails working with many people who have never had experience doing it; it entails long project timelines within which there may be a turnover of key personnel; it entails a geographical spread that covers the entire country; and it requires the cooperation and collaboration of a range of organizations, both public and private. The present section details various issues related to the administration and management structure of a census.

1. Responsibility for census enumeration

2.93   There is wide variation in the organization of national statistical systems around the world. In a centralized national statistical system, the national statistical office is the main data collection agency and coordinator of all government statistics in the country. In other countries, the census-taking agency is just one of many statistical units that reside in various government ministries or departments. There are also a few countries where there is no permanent statistical office responsible for the census. Therefore, the management structure that is put in place for the census largely depends on the established management structures in the national statistical system. Despite the variation, in a majority of countries, a national statistical office is the organization responsible for the census. There are many references available on this subject and it is impossible to discuss the full range of options available in a handbook such as this.

2.94   For the purposes of the present handbook, a generic structure is discussed that can be adapted by countries to suit their own particular circumstances.

2.95   Since censuses are not taken frequently, there is a need for a well-developed management process to ensure that information acquired in one census is utilized to the fullest extent possible in future censuses. Also, there are some management issues that are specific to a project with a long lead time. In addressing these issues it should be expected that the management team leading the development of a census may change over the course of the planning and preparation phases that comprise the census development process.

2.96   In the earliest stage, the principal activity will be identifying possible options for the various aspects of taking the census. It should be expected that at this time the team structure will be based around a small group of experienced and relatively senior staff. The team should be managed by a person experienced in addressing strategic issues and with some experience in census taking.

2. Hierarchy of census staff

2.97   A generic structure of the organization responsible for the census is illustrated in figure III. The roles and responsibilities of each level in the generic structure are also discussed. See annex II for Myanmar's 2014 organogram.

Figure III

Top-level management structure at the national level: example
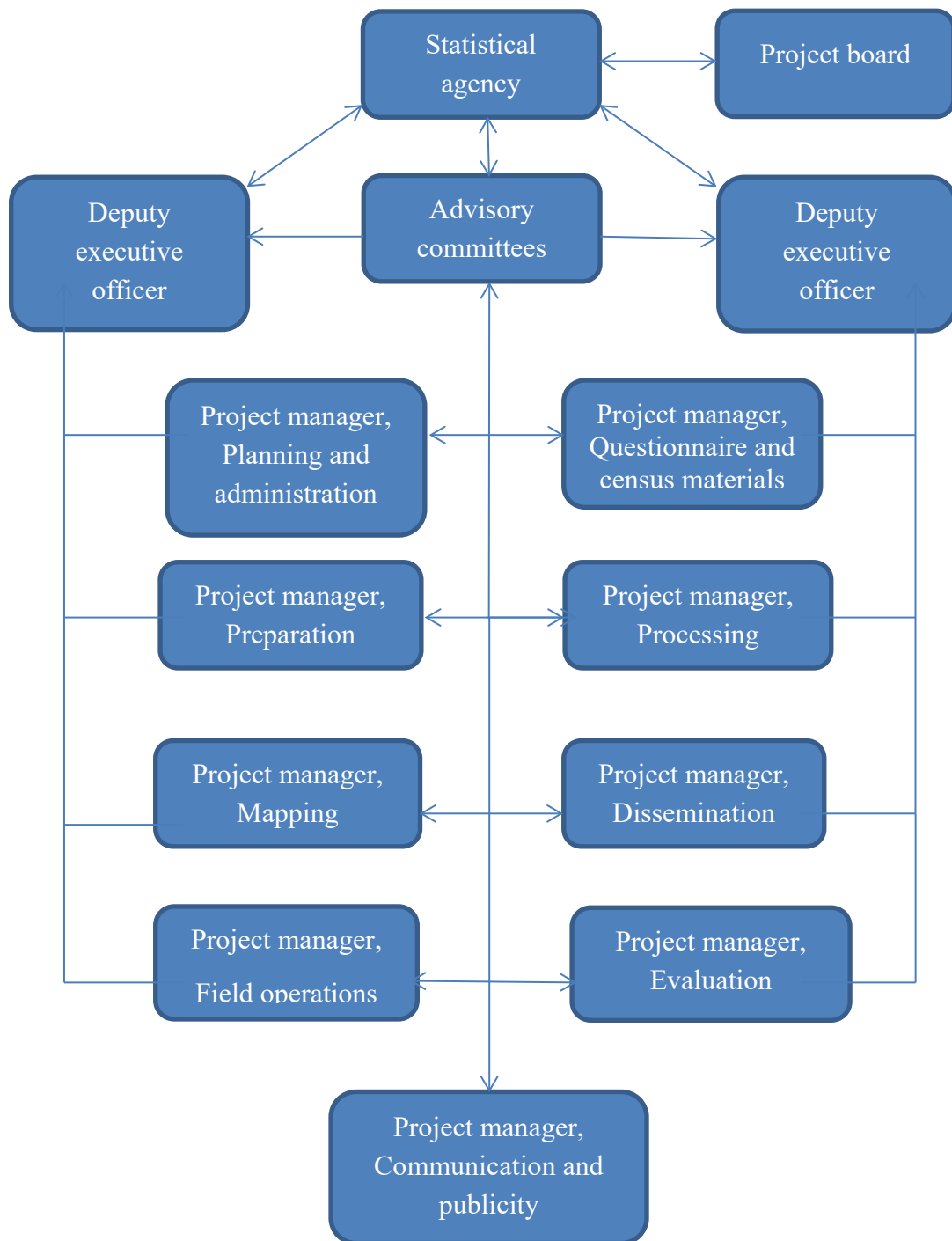
2.98   The number of staff employed in each area of the diagram in figure III will vary over the census cycle as different project teams are deployed through the phases. Also, the number of levels in the management structure may change throughout the census cycle. For example, there may only be one project manager responsible for both questionnaire content and

administration in the early stages of planning. However, an important point to note is that the management structure includes each phase of the census cycle.

2.99   There are also other areas within the statistical agency having an input into the census project that are not represented in the diagram, such as the areas responsible for human resources or network security.

2.1   *Statistical agency executive officer*

2.100   The executive officer is the person responsible for the census within the executive structure of the statistical agency.[26] This person has ultimate line management responsibility for all aspects of the census and takes responsibility for the eventual delivery of census goals. The executive officer will usually report to the statistical agency executive.

2.101   The responsibilities of the executive officer can be defined as:

(a) Establishing strategic objectives for the census programme;

(b) Setting expectations and outcomes;

(c) Taking on responsibility for assessing and ratifying the census programme's feasibility and achievement of outcomes;

(d) Ensuring that the census programme's scope aligns with the requirements of the stakeholder groups;

(e) Providing those directly involved in the census with guidance on strategic issues;

(f) Ensuring that effort and expenditure are appropriate to stakeholder expectations;

(g) Keeping the census programme's scope under control as emerging issues force changes to be considered;

(h) Reconciling differences in opinion and approach between stakeholders and resolving disputes arising from them;

(i) Communicating expectations and critical decisions to the executive management of the statistical agency;

(j) Allocating project resources;

(k) Addressing any issue that has major implications for the census programme.

2.2   *Deputy executive officers*

2.102   The number of staff at this level largely depends on a particular country's circumstances and the size of the census project. These officers report directly to the executive officer and can be responsible for several of the phases in the census cycle.

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[26] In some countries, the census is conducted by an agency other than the national statistical office.

2.103   Their responsibilities can be defined as assisting the executive officer in all areas of responsibility included in the list above. Deputy executive officers are a key link in the communication chain between project managers and the census agency executive and other areas within the statistical agency. Their role is more "hands on" than the executive officer and they are more closely involved with the day-to-day activities of the project teams.

2.3   Project managers

2.104   In this structure, a project manager is responsible for each phase of the census. Project managers are responsible for several project teams that will be established for each phase (figure IV). They should schedule and monitor all activities of project team members and they should be separately identified in the workplan.

2.105   The responsibilities of the project managers can be defined as:

  (a) Developing and maintaining project plan(s);

  (b) Managing and monitoring project activity through the use of detailed plans and schedules;

  (c) Reporting to the deputy executive officers as required;

  (d) Managing stakeholder expectations;

  (e) Liaising with all project stakeholders;

  (f) Fostering communication among all project stakeholders;

  (g) Negotiating the resolution of technical issues;

  (h) Completing the project on time and within the budget;

  (i) Ensuring the quality of the deliverables.

Figure IV

Example of a project team structure
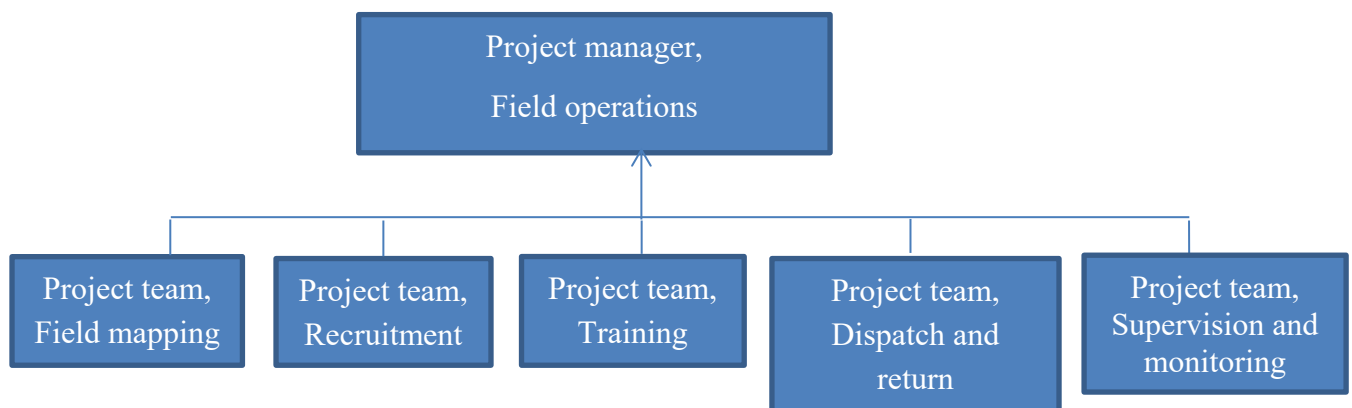
2.4   Project teams

2.106   As options for the various strategic issues are established, the management structure should be refined so that series of project teams become established in parallel, each looking after broad areas of responsibility.

2.107   Each project team should be responsible for maintaining contact, at appropriate levels, with external stakeholders, including other areas of the census team, other areas of the national statistical agency and stakeholders external to the agency (such as other government agencies).

2.108   The project teams are responsible for:

(a) Completion of project tasks to the agreed timetable;

(b) Completion of project tasks to agreed and accepted levels of quality;

(c) Peer group reviews of project outputs.

2.109   To ensure that there is the greatest possible scope for the coordination of activities between the various project teams, these teams need to be co-located. If this is not possible for some reason (for example, location of stakeholders with particular expertise or requirements remote from the main census development site), allowance must be made for sufficient communication and face-to-face meetings between members of the various project teams.

2.110   As the development work progresses, it should be expected that the development project teams will increase in size, as the level of detail involved in their work increases. Eventually, these teams are likely to form the basis of the core management teams undertaking the operational aspects of the census, and the structure of the project teams should incorporate an element to facilitate this evolution.

2.5   Project board

2.111   The project board is a high-level group comprising representatives of major stakeholders in the census programme and other areas within the statistical agency. The project board may be chaired by the census agency executive officer.

2.112   The project board should be seen as an advisory body that provides advice to the executive officer on strategic directions and issues. In the early stages of census planning, it is vital to coordinate the disparate activities of the programme and recognize interdependencies. This will be greatly facilitated by the formation of a review body such as a project board.

2.113   Representatives on the board from other areas of the statistical agency may also be able to provide high-level specialist advice to the executive officer. These representatives could be from specialist areas such as IT.

2.114   Once the operational phases begin, the role of the project board will be largely complete. However, the board can have a continuing role in identifying strategic directions for the next census.

2.6   Use of advisory committees

2.115   The project board is only one of a number of formal mechanisms that managers of a census can utilize to gain access to levels of expertise and experience augmenting those of the team, which is the key role of such committees. They do not absolve the census managers from their responsibility to manage the operation.

2.116   In many cases, the formal systems adopted by the agency will indicate the review and advisory boards that should be involved. It is suggested that the following groups are essential to ensure that the development process considers all key issues:

(a) An IT review panel to ensure that the most effective use is made of technology, without requiring the development team to be fully conversant with all aspects of this area;

(b) One or more system user review groups to ensure that the views of the people who will operate the system are considered;

(c) One or more technical advisory groups to provide advice on the need for statistical output in specific areas (particularly useful as a means of addressing emerging areas of concern);

(d) Other technical advisory panels, where required, for example a panel of methodologists may be helpful in determining sampling rates, or a panel of specialists on employment conditions may be useful if the area of pay and conditions is complex.

2.117   Again, the most use should be made of these committees in the planning and preparation phases and not in the operational phases. This is because their main role is to provide advice on strategic issues or particular technical issues. It is unlikely that such committees will be able to respond quickly enough to resolve issues of detail that may arise during the brief and intense operational stages of the census.

2.7   Differences between development and operational phases

2.118   While the top-level management structure is established in principle for the entire census cycle, the extent to which all parts of the structure are actually deployed will vary over the cycle. It is important to note that the detailed management structures and approach will be quite different for the operational phases of the census as compared with the development phases.

2.119   The development phases comprise planning and preparation, and detailed management structures are suited to these phases. The operational phases comprise mapping, questionnaire development, field operations, processing and dissemination. These require

different management approaches because the nature of the workforces and the tasks performed are quite different. These are discussed in the following sections.

2.120   Box 3 presents an example of a census governance structure from the 2011 census in South Africa.

Box 3. Example of census governance structure: 2011 census in South Africa

The success of any census not only depends on how the various activities are implemented and monitored, it also relies greatly on governance bodies that enhance the efforts of the teams that are mandated to execute the activities. It is in this regard that the following oversight bodies were established.

- The South African Statistics Council guides and advises on statistical matters as mandated in the Statistics Act.

- The Census Steering Committee forms the core of census project management, with the role of monitoring implementation and decision-making.

- Provincial advisory committees enhance the ownership of the census programme externally and engage stakeholders at a localized level.

- Technical working committees give technical inputs in specific methodological focus areas and comprise subject matter specialists from within and outside the organization.

Source: Statistics South Africa.

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3.   Management structure by operational phase

2.121   The main operational phases of a census are mapping, questionnaire development, enumeration, data processing, data dissemination, evaluation and archiving. In addition, publicity is an operation that happens at various points through the census project – before various tests and the pilot, before and during enumeration, and during dissemination. The progress and success of each phase have an impact on the one that follows and bear the impact of the one that precedes it. For instance, an incomplete and inaccurate mapping operation will result in an enumeration phase that is riddled with coverage problems. Also, if the mapping operation is not completed in a timely manner, enumeration may be delayed. During the operational phase, the census programme will be concerned with operational management, driven by output from monitoring systems established in the development phase.

2.122   Linking the different operational phases of the census is crucial for effective integration of activities in each phase. Census plans are often developed and implemented in silos, despite the recognition of the dependencies between the phases. It is challenging to operationalize integrated planning owing to the large number of stakeholders involved in each phase, and the challenge of ensuring accountability and ownership across the spectrum of census activities.

2.123   Achieving effective integration of activities and quality outputs within prescribed time frames is therefore a function of two main drivers: (a) a project management office with effective monitoring and evaluation systems to provide informed management reports and updates on the progress of census phases (including logging risks, control measures and mapping dependencies); and (b) spatial and technological components of census phases, which serve as key integrators if they are embedded as cross-cutting work areas. The challenge of managing census phases in an integrated manner requires a streamlined project management office, underpinned by a clear governance structure that ensures accountability.

2.124   At the beginning of each operational phase, the generic management structure discussed above will have to be expanded to cater for managing these operations. As an example, the field operations management structure could be expanded.

2.125   Details of the management of the three main operational phases of the census are given in the relevant chapters of the present publication. It is, however, worth considering key elements of the specific structures required in an overall sense.

3.1   Pre-enumeration phase

2.126   The pre-enumeration phase includes the management of several important operations and activities, such as communication and publicity, mapping, recruitment, questionnaire development, finalization of administrative or geographical units, manual development, printing and training. Different units will be responsible for each of these. Depending on the statistical office, mapping and publicity may be done in-house or outsourced. If mapping is done in-house it is usually the cartography or geography department that handles the mapping project. However, it may have to coordinate and collaborate with other government agencies that collect spatial data to create the database for the entire country. This is discussed in greater detail in chapter III.

2.127   Similarly, communication and publicity have to be planned and managed by staff that are exclusively responsible for messaging and communicating with the various stakeholders, internal to the Government as well as external, including data users and the public. For the United States census in 2010, the Census Communications Campaign of the United States Census Bureau built on the success of the Census 2000 Partnership and Marketing Program, which helped to reverse a two-decade-long decline in the national mail response rate. For 2010, the Census Bureau took an integrated approach to communication activities that went beyond advertising to include a mix of public relations, partnerships, grass-roots marketing, special events, and more. By integrating these elements with each other and with the Census Bureau's internal operations, the campaign helped to ensure that all people were reached in the most efficient and effective manner. The Census Bureau awarded an integrated communications contract to help to implement many components of this campaign along with Census Bureau employees. For the 2010 census, this was the third largest contract.

2.128   Senior subject matter specialists in the organization should lead and staff the questionnaire development operation collaborating with partner agencies, organizations,

academia and the data user community. If an electronic census questionnaire is being designed, teams have to work closely with the IT unit and its programmers. Establishing clear channels of communication and responsibility is central to the success of this process. Subject matter specialists should be engaged to lead the questionnaire development process even if it is an electronic questionnaire. Programmers are not likely to be sensitive to or trained in the principles of designing a questionnaire.

2.129   Overall, each of the operations in this phase should be headed by a project manager, who reports to the census executive officer. The internal management structures of these will vary depending on the pre-enumeration activity.

3.2   Enumeration phase

2.130   A key element of the field enumeration management structure is that it will inevitably be geographically dispersed (see figure V). This is needed to provide the local knowledge required to ensure high-quality enumeration and to ensure ready access to managerial advice and oversight for enumerators.

2.131   It is not possible to be prescriptive about the way in which this is achieved since the resources available to countries as well as the size of countries will differ greatly. Depending on the communication facilities and other infrastructure available in a country, it is common for the basic management structure to involve three or four layers of management in the field operations workforce, as follows:

  (a) Regional manager;

  (b) Deputy regional manager;

  (c) Supervisor;

  (d) Enumerator.

2.132   The first two levels should be combined if it is possible to accomplish the enumeration operation with only a regional manager. It is desirable to minimize the hierarchical levels of staffing in order to facilitate direct communication between enumeration staff and more senior managers. It is important to ensure that each level of staff is encouraged to accept responsibility for their own work and be competent.

2.133   It is equally important to maximize communication between management units to ensure consistent adoption of best practices in all areas.

2.134   Typically, the field workforce will comprise mainly staff engaged in the specific task at hand. To ensure objectives are met they will require management support from permanent staff of the census agency. This element of management can be provided effectively through regional offices where they exist. In other cases, it may be possible to use other management structures (for example, those of the education department, where it is considered effective in terms of national objectives to utilize teachers as the enumerators).

2.135   In most countries, there will also be special subgroups of the population that require particular management actions to ensure a successful enumeration. For example, these groups may comprise members of a specific population group (such as an indigenous minority), or people with some form of disability (such as visual impairment or poor reading skills), or people who live in specific situations (such as a nomadic minority group or homeless people). In each case, a specific strategy will be required incorporating the necessary management structures.

3.3   *Processing phase*

2.136   The success of the census-processing phase is determined largely by the structures established to manage the operation. The structures that can be put in place at each processing centre are discussed in chapter V.

2.137   However, if the processing is conducted at a number of decentralized sites, an additional management layer will be needed. In a decentralized scenario, there is a strong need for overall national coordination of operational and quality assurance aspects of the processing task. Therefore, national managers will need to be engaged who are responsible for these two aspects of processing.

3.4   *Dissemination phase*

2.138   A number of options are possible for the management structure of the dissemination phase of the census. The overriding requirements are that there should be:

  (a) A great deal of attention paid to coordination with the enumeration and processing systems;

  (b) Due attention given to the use of standard classifications across the entire range of outputs;

  (c) A process that is based on a clearly detailed set of user objectives;

  (d) Project management tools to manage timetables and other deliverables.

2.139   When preparing output products, an efficient approach is to establish teams that are given responsibility for developing particular products over the entire product development cycle. The alternative approach is an assembly line process whereby different teams are responsible for different aspects of the product development.

2.140   The team-based approach will give the team members ownership of the products and ensure a consistent approach to the development of particular products. Defining the boundaries of a team's responsibility is best undertaken in consideration of the level of complexity of the outputs envisaged. A different approach may be required in countries in which most users do not have access to computers, or where great importance is attached to providing output to local groups, as compared with countries with sophisticated data-

handling systems where most information is passed electronically (for example, through the Internet).

2.141   Where the outputs required are relatively simple, a suggested approach is to structure the teams on the basis of principal topics covered by a team. For example, one team could be responsible for basic demographic output and another for labour force topics, and so on.

2.142   If the outputs are relatively complex, or require more advanced use of technology, it could be more appropriate to form a few teams with a mix of subject matter and IT skills. These teams could work on digital dissemination or interactive digital products.

4.   Structure of the workforce

4.1   Introduction

2.143   The present section describes the geographic, logistic, communication and social factors that have to be considered when determining the structure of the workforce to support the enumeration phase.

2.144   As described above and taking into account the basis of enumeration, it is common for the basic management structure to involve three or four layers of hierarchical management. It is desirable to minimize the number of levels in the hierarchy, while ensuring that quality and continuity do not suffer as a result.

2.145   In many countries, the existing administrative structure, both centrally and in the regions, will also be used to facilitate the management and coordination of the enumeration activity. This varies considerably from country to country.

2.146   Apart from enumerators, other specialist staff may also be employed to undertake tasks such as mapping and household listing (see chaps. III and IV) or the enumeration of institutional and collective dwellings. In some countries, these tasks may be undertaken by enumerators and managed by the structure shown below.

2.147   Assuming a hierarchical structure, there are a number of key issues that the statistical agency needs to address in formally determining the structure of the workforce. These include:

   (a) Roles and responsibilities of each level;

   (b) Time available;

   (c) Staffing ratio between the different levels.

2.148   These issues are interrelated and dependent on one another and should not be considered in isolation. For example, the amount of time available may well determine the roles and responsibilities, which in turn will affect the staffing ratios.

4.2 Roles and responsibilities

2.149   The roles and responsibilities at each level will vary and will depend on the basis of enumeration. However, they will always involve some form of management, supervision and communication with the level immediately below, and communication with the level immediately above. Several enumerators will be dealing with one supervisor, and several supervisors will be dealing with one deputy regional manager or regional manager. The roles and responsibilities of each level must be clearly defined in the various instruction manuals that need to be produced, and they should be reinforced during training.

(a)   Regional manager

2.150   The role of the regional manager will include work similar to that of the deputy regional manager. At this level, work will also involve public communication activities and liaison with targeted government and community groups. This will help to promote census awareness, which will assist field staff during enumeration.

2.151   There would normally be little direct contact with respondents or enumerators, thus regional managers do not play a strong role in direct quality assurance of the census enumeration. They do, however, play a strong role in the quality assurance of the census field administration. For example, where a recruitment and selection process is used for enumerator positions, the regional manager may be responsible for vetting selection documentation and approving appointments. Similarly, they may be responsible for approving payment of salaries and expenses.

2.152   Regional managers would communicate on a regular basis with the statistical agency but usually this would involve progress reporting rather than seeking advice or assistance.

(b)   Deputy regional manager

2.153   The role of the deputy regional manager is dependent on the basic structure of the field operations. The present handbook assumes that there is a four-tier structure where there is a deputy regional manager position. This will vary from country to country. For example, if there is only a three-tier management structure, the roles of the deputy and regional managers should be considered together.

2.154   Where the role of the deputy regional manager is primarily administrative in nature, the need for frequent (or daily) communication between these two levels is less, as is the need for face-to-face communication. Telephone contact, where available, may suffice for most of the duration of the operation.

(c)   Supervisors

2.155   In terms of administering the population and housing census, field supervisors represent a key linkage between the operators in the field and the upper hierarchical management structure. In that regard, their performance has a crucial impact in terms of efficiency of the enumeration and the quality of resulting statistics. The fact that they have supervising responsibilities and, at the same time, the sheer number of needed supervisors,

may represent key challenges and risks in terms of field enumeration. As an example of their role and impact, supervisors should contact each of their enumerators, either in person or by other means such as telephone, on each day during the actual enumeration period, which, in itself, requires strong managerial and communication skills.

2.156   At the very start of enumeration, the supervisor should spend some time with each enumerator doing on-the-job training (see chaps. IV, sect. B). Supervisors should also ensure that no area is left out or overlapped between enumeration areas under their jurisdiction. Distance and travel time are key factors and it may be necessary for some enumerators to start delivering forms or conducting interviews before their supervisor can join them to observe. In these cases, it is even more important that the supervisor, if at all possible, be in contact with the enumerators at some stage during the day to ask about the day's work and to check on issues that may have arisen.

2.157   During enumeration, supervisors will undertake quality assurance tasks (see chap. IV, sect. D). These tasks are critical and sufficient time must be allowed both during enumeration and between the end of enumeration and when the forms must be dispatched to the processing centres. If supervisors have too many enumerators, they may not be able to allocate sufficient time to quality assurance. This may result in errors in the data that should have been corrected in the field.

2.158   If the supervisor has substantial administrative responsibilities in addition to training and supervising enumerators, this will have a significant impact on the available time for quality assurance tasks. The prime focus of the supervisor should be on quality assurance rather than on administrative tasks such as completing remuneration documents for each of their enumerators. The role and responsibilities of supervisors should reflect this.

2.159   If electronic questionnaires are used in the field (box 4), supervisors will have responsibilities such as ensuring the safety and security of the equipment, electronic assignments of workload, liaising with IT personnel on resolving technology issues, and ensuring the maps on the handheld devices reflect accurately the household buildings and boundaries in the field. On the other hand, they may be relieved of timekeeping and payroll responsibilities if the operational control technology automatically records enumerator work, movement and progress through the day.

2.160   As contemporary censuses tend to extensively apply IT in a number of different ways, there is a need to develop a fully functioning technical support system available to supervisors around the clock in the field. This mechanism is necessary irrespective of the level and number of mobile devices as it is certain that supervisors would use some of the mobile devices for communication and supervision.

Box 4. Resolving IT-related problems in the course of data collection with personal digital assistants in the 2010 census in Cabo Verde

The use of an electronic questionnaire in the census demanded a new form of supervision of the data collection. In addition to traditional supervisors, INECV deployed a team of IT supervisors

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who supported the field teams in resolving the difficulties the enumerators faced during the course of data collection in handling the equipment, navigating the questionnaire, and buffering the PDAs. The IT supervisors also monitored in real time all phases of data collection, transmission and consistency.

Source: Instituto Nacional de Estatística, Cabo Verde.

(d)   Enumerators

2.161   Enumerators will usually work under general direction, following well-prescribed procedures and guidelines. While enumerators can be expected to solve some problems by reference to documentation, they will, on occasion, require assistance or direction from their supervisor.

2.162   The work of enumerators will usually involve a mixture of:

(a) Proper identification of the enumeration area and the preparation and update of the enumeration area map;

(b) Contact with respondents (including interviewing, where this method is used), which will involve representing the statistical agency to respondents, answering queries about the census and providing assistance, as needed;

(c) Clerical work at home and in the field, which will involve understanding and applying procedures and guidelines, and providing feedback;

(d) Travel to and from, and around, the enumeration area.

2.163   The mix of these will vary depending on the basis of enumeration and the specific circumstances encountered.

2.164   During the peak enumeration period, enumerators will spend most of their time in the field. Therefore, they will usually only be available to report to their supervisor in the evenings, or on their way to or from their enumeration area. This means that in many cases, in particular those involving complex situations, supervisors will need to locate and meet their enumerators in the field to check on progress and problems. In cases where face-to-face meetings are not required, enumerators and their supervisor could address the issues that arise in fieldwork using contemporary communication devices (such as telephone, SMS or email).

2.165   If electronic questionnaires are used, enumerators will have additional responsibility related to maintenance and security of the handheld devices and the transfer of data, perhaps even updating inaccurate maps.

(e)   Regional information technology officers

2.166   For censuses that use electronic questionnaires and operational control systems, there is a need for IT support personnel at the regional office level. Each regional office should have an IT expert who can troubleshoot technical problems and assist with data transfer if needed. These personnel will generally work with the regional manager, but report to the

manager for data processing. In such cases, lines of responsibilities should be transparent to avoid conflicts between layers of supervision.

2.167   Figure V provides an example of a field operations management structure, while box 5 gives an actual example from India.

Figure V

Example of a field operations management structure
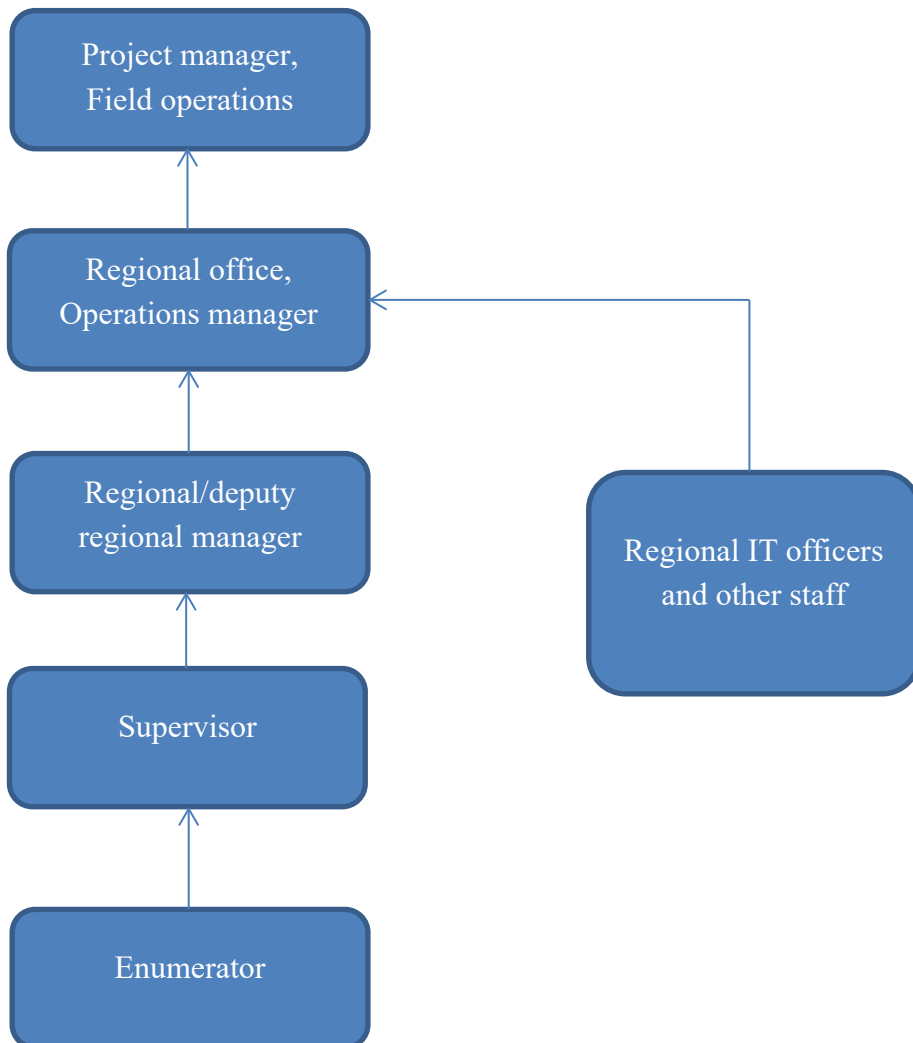
Box 5. Field operations management structure: India

In India, the Registrar General and Census Commissioner, India, under the Ministry of Home Affairs, Government of India, discharges the statutory responsibility of conducting decennial censuses. The Registrar General and Census Commissioner, India, overseeing 33 directorates of census operations, is responsible for planning, execution and successful completion of census processes in the entire country. The directors of census operations supervise the census activities in their respective states or union territories.

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┌─────────────────────────────────────────────┐
│   Registrar General & Census Commissioner,   │
│              India (At National Level)        │
└─────────────────────────────────────────────┘
                      │
                      ▼
┌─────────────────────────────────────────────┐
│        Directorates of Census Operations      │
│              (At State/UT level)              │
└─────────────────────────────────────────────┘

    Census Designation          Officers Appointed

┌──────────────────────┐   ┌──────────────────────┐
│ Principal Census      │   │ District Magistrates/ │
│ Officer (At           │   │ Collectors/           │
│ District/City level)  │   │ Commissioner of       │
│                       │   │ Corporations          │
└──────────────────────┘   └──────────────────────┘

┌──────────────────────┐   ┌──────────────────────┐
│ Charge Officer        │   │ Tahsildars/           │
│ (At Sub-District/     │   │ Mamlatdars/           │
│ Town level)           │   │ Executive Officers    │
└──────────────────────┘   └──────────────────────┘

┌──────────────────────┐   ┌──────────────────────┐
│ Enumerators and       │   │ Teachers, other field │
│ Supervisors           │   │ officials etc. of     │
│                       │   │ State Govt. & local   │
│                       │   │ bodies                │
└──────────────────────┘   └──────────────────────┘

┌─────────────────────────────────────────────┐
│ The Secretary of the Nodal Department of the  │
│ State/UT acts as Coordinator between Centre    │
│ and State/UT for smooth conduct of Census      │
└─────────────────────────────────────────────┘
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4.3   Time available

2.168   Another factor in establishing the structure of the workforce is the amount of time required for communication between people at different levels in the hierarchy. For example, each contact between enumerators and their supervisor will take a certain time. Where distances are relatively great, the travel time required for face-to-face contact, if absolutely necessary, can be a significant part of the time required for supervisors to undertake their duties. Similar issues must be considered in planning for other levels in the hierarchy.

2.169   The period of greatest demand on the time of staff is the actual enumeration period (several weeks on either side of census day), when all staff are engaged in operational tasks relevant to their own level. This is also the period when they are subject to the greatest demands for across-level communication. As this is the most important period in the

operation, it is the period in which the demand on the time of staff at all levels in the structure must be considered.

2.170   Budgetary considerations will also be a factor and may require that the staffing ratios are higher than would otherwise be desirable. The task is to find the right balance between cost and quality in the form of available time.

4.4   Staffing ratios

2.171   For effective and efficient conduct of field operations, the ratio of supervisor to staff at any level within the field operations management structure is dependent upon a number of factors. The frequency, duration and mode of communication between supervisors and their staff are the key factors that should be considered when determining the ratio. Communication of the priorities and the work to perform, in particular at lower levels in the structure, is a key success factor for effective and efficient field collection activities.

(a)   Regional manager-deputy regional manager ratio

2.172   This ratio depends to a large degree on the top-level structure of the census and whether regional managers are employed within the statistical agency or are part of the temporary collection workforce.

2.173   Where the regional managers are permanent employees of the statistical agency they will generally have support such as office facilities and personnel to assist them in managing communication with their deputies. Also, their existing experience in statistical data collection and the security of their government jobs could allow these staff to perform more reliably.

2.174   Where the regional managers are temporary employees, the ratio with deputies will be dependent on such factors as whether the regional managers are office or home based and how much of their role involves direct contact (for example, in the case of training) with deputies or lower-level staff.

(b)   Deputy regional manager-supervisor ratio

2.175   The deputy regional manager-supervisor ratio also takes into account available time but focuses more on the administrative and management roles of the two levels in the overall structure.

(c)   Supervisor–enumerator ratio

2.176   The supervisor–enumerator ratio is the most important, as it has the greatest impact on dealings with the public during enumeration. The number of enumerators reporting to each supervisor has a direct bearing on the amount of time a supervisor may spend with each enumerator in training and in the field. It will also have an impact on the amount of quality assurance that can be performed on the work of enumerators before the census forms are returned for processing.

2.177   If supervisors have too many enumerators to supervise, they may be unable to give sufficient attention to each individual. This may also affect their communication with their own manager and their ability to relay messages promptly.

2.178   Establishing the ratio of supervisors to enumerators cannot be done by formula and will involve some level of qualitative rather than objective judgement. It is also likely that the ratio will vary within a country (for example, between urban and rural areas) owing to differing conditions in the various areas. Many countries use a 1:10 ratio but this may vary depending on a myriad of issues to be considered. The opportunity of field tests should be used to confirm the feasibility of the general supervisor–enumerator ratio.

2.179   In comparison to paper questionnaires, using electronic questionnaires will certainly affect the duties of supervisors and enumerators, which should be taken into consideration for establishing the ratio.

5.   Human resource management

2.180   Developments in census methodologies and technology during the past several decades have changed significantly the practice of census operations, and these changes have presented managers with many opportunities and challenges, especially in terms of ensuring adequate number and professional profile of necessary staff. Therefore, early arrangements are necessary for securing the proper number and type of staff required for each of the various census operations.

2.181   Management of human resources for census operations is of particular importance in the planning phase of the census. Every census requires careful planning for human capacity development for successful planning and implementation of census operations. In many countries, lack of human capacity is one of the most significant concerns for planning the next census owing to the mobility of staff. Growing interest in using new technology and improving census methodologies is also an important factor for careful planning of human resources.

2.182   Census agencies need to integrate human resource strategies into census planning. For this purpose, census managers and human resource managers need to work together to fully integrate these schemes into the planning process so that it will become a fundamental, contributing factor to census planning. For census operations, strategies for human resource management are developed in two stages: (a) strategies for office work; and (b) strategies for fieldwork.

5.1   Human resource strategies for office work

2.183   As the first step, statistical offices need to analyse the existing human resources at a very early stage of census planning, and develop strategies to secure the office staff required for successful implementation of census activities. These strategies should be developed by taking into account the following issues: (a) maximizing the capacity of the existing staff;

(b) needs for recruitment of new staff; (c) needs for new skills on a permanent or temporary basis; and (d) tools for developing capacity.

2.184   Census managers should carefully analyse the existing human capacity and the gap with the capacity required for the planned methodology. Following this assessment, it is necessary to evaluate if there is a need for recruiting new staff with particular skills, or improving the skills of existing capacity. This step is indeed critical and consideration should be given to cost-effective tactics, as some skills might be required only for a short period of time and it would be too costly to keep them on a permanent basis, such as developing software or setting up IT systems. Consequently, this phase of assessing the needs for new skills will also provide inputs for giving a decision on outsourcing of census activities.

2.185   Once the redeployment of existing staff to specific census activities has been decided and implemented, a specific training programme needs to be designed for them. The content and timing of the training programme should be prepared well in advance. The training programme and its schedule is one of the first activities in the planning phase and requires careful management, as it should be organized in close cooperation with census planners. Capacity-building activities can be implemented through various ways, for example:

(a) In-house training programme on specific methods, procedures, and technology;

(b) Participating in the training programme organized by national and international organizations;

(c) Study visits to learn from practical experiences;

(d) Consultation services during planning and implementation stages for certain activities.

2.186   Box 6 presents an example of strategies for human resource management from the 2011 census in India.

Box 6. Strategies for human resource management: 2011 census in India

In order to cope with the additional workload during the decennial population census and to achieve the targets in a time-bound manner, the organization of the Office of the Registrar General, India, including the directorates of census operations in the states and union territories, was strengthened in terms of human resources. For the 2011 census, in addition to the regular employees in the Office of the Registrar General and directorates of census operations, about 695 additional temporary posts, comprising 387 statistical posts, 63 cartographic and mapping posts, 48 electronic data-processing (IT) posts, 25 printing posts and other supporting posts, were created for a period of three years, or for two years with some reduced posts.

It is the practice for district and subdistrict officers to be appointed as census officers with the responsibility of ensuring the smooth conduct of the Indian population census in their respective administrative areas. They discharge their census responsibilities along with their normal responsibilities, and their offices are thus provided with clerical and other assistance for census-

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related office work. For the 2011 census, 8,634 clerical and supporting posts were created for a period of 18 months (December 2009 to May 2011) in these offices.

The temporary posts created for census purposes in the Office of the Registrar General, directorates of census operations, and district and subdistrict offices were filled by borrowing government officials from other government offices or by engaging retired government officials on a monthly payment basis.

The main functionaries responsible for the collection of data in the field – enumerators and supervisors – were drawn from teachers and other local field officials of the respective state government and local bodies. These officials discharged their census duties in addition to their normal duties on payment of a nominal honorarium. During the 2011 census about 2.7 million enumerators and supervisors were employed.

Comprehensive training was undertaken for all categories of census functionaries, including the regular census employees. During the 2011 census, a three-tier cascade of training was developed. At the top of the pyramid was a group of 90 national trainers, who undertook a five-day course at a residential training camp. The national trainers trained 725 master trainer facilitators at the state level, who in turn trained 54,000 master trainers at the district level. The master trainers ultimately trained the 2.7 million enumerators and supervisors at the field level.

5.2   *Human resource strategies for fieldwork*

2.187   Another aspect of human resource management is the development of plans for the field staff, who are usually employed on a temporary basis. This category of staff requires careful consideration in terms of the qualifications needed for census work and availability of adequate numbers of suitable individuals in all parts of a country. Alternative approaches might be needed if there is a risk of not finding enough skilled staff in each region of the country;[27] in this case, there might be a need for a special training programme in some areas for gaining specific skills, such as use of tablet computers, or awareness of cultural and gender sensitivity.

2.188   The enumeration phase of the census requires a large number of staff on a temporary basis. The method of acquiring them needs to be worked out carefully to facilitate transparent hiring according to the required skills for each type of field staff, such as enumerators, supervisors and administrative officers for regional committees. It is essential that the enumerators and their supervisors be conversant with the languages or dialects of the area in which they will be working. It is also critical that the whole process of recruiting is well publicized and completely transparent in terms of the qualifications needed, and that the compensation offered for working in the census is competitive enough in terms of attracting the most adequate candidates.

2.189   In general, training of field staff is organized in a hierarchal way, in which there are several levels of training in field operations and each level trains those below them. This is

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[27] Some countries primarily recruit schoolteachers or university students as census enumerators.

usually an efficient way of training large numbers of people in a short time. While a hierarchal training programme has many advantages, such as allowing the training in a timely manner and establishing a clear line of authority between the field staff, provisions need to be made in cases where supervisors assigned to training prove to be inadequate teachers. Detailed information on the training of field staff is provided in chapter III, section G.

2.190   Box 7 provides on example of methodologies applied to hiring enumerators for the census in India.

Box 7. Hiring enumerators for the census in India

For the Indian census, it is usual to appoint primary and middle school teachers or other field officials of the respective state or union territory government or local bodies as enumerators or other functionaries, in accordance with the provisions of the Census Act, 1948, and Census Rules, 1990. The teachers are given first preference for appointment as enumerators, as they are available in almost all enumeration areas and are capable of collecting qualitative data by virtue of their rapport with the household members in those areas. They discharge their census duties in addition to their normal duties on payment of a nominal honorarium.

The Census Act, 1948, which governs census taking in India, protects the service interests of members of the census staff, and clarifies the census duties of functionaries and their lending employers.

E.   Census legislation

2.191   Legal authority for the census is required for regulating primary administrative responsibility, obtaining the necessary funds, determining the general scope and timing of the census, and placing a legal obligation upon the public to cooperate and provide truthful answers, a legal obligation upon the enumerator to record the responses faithfully, and specific responsibilities upon other census field personnel at various supervisory levels. In addition, the confidentiality of the individual information should be strongly and clearly established in the census legislation and guaranteed by adequate sanctions so as to provide a basis for the confident cooperation of the public. In some countries it is considered important to set clearly in the census legislation penalties and fines for the public and the census field personnel who do not cooperate. In countries that lack permanent legal authority for the taking of periodic censuses, it is important to act early to establish ad hoc legal authority or, preferably, legislation calling for a system of periodic censuses.[28]

2.192   Census legislation governing census activities is one of the first aspects to be considered when starting to plan the population and housing census, since it constitutes one of the most important instruments for facilitating the census work. The content of the census legislation inevitably depends on national legal practices and procedures, as well as the organization of the national civil service. In preparing census legislation particular attention

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[28] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 2.69.

needs to be paid to the fact that every legislative procedure is a time-consuming process; hence, the submission of legislation has to be planned and implemented accordingly.

2.193 The legislation should provide the statistical agency with the flexibility of determining the types of data to be collected and selecting appropriate methodologies, considering the conditions at the time of the census. It is desirable for any census legislation to cover such necessary details as the authority to conduct the census, development of detailed activity plans regarding the field enumeration, the responsibilities of regional census offices, and the main duties of regional census managers, supervisors and enumerators.

2.194 The precise content of the census legislation depends on national legal practices and procedures, as well as on the organization of the national civil services. The legislation usually covers the following subjects.

(a) **Scope and coverage.** The coverage of the census is usually indicated in the census law in general terms. The scope of the topics to be covered is presented in broad categories to provide the census agency with the desired flexibility in planning the operation and in including the types of data pertinent to the time the census is taken.

(b) **Periodicity.** The periodicity of census operation is usually determined in the census legislation. This act would establish the legislative or budgetary authority for the census to be taken at regular intervals and for the provision of the necessary funds. The census agency can therefore plan well ahead before the scheduled date.

(c) **Responsibility for the census.** The primary administrative body responsible for the census should be indicated in the legislation; however, it may call upon other government agencies to participate in the census either with a coordinating function or by providing assistance or personnel.

(d) **Administrative and financial provisions.** The legislation should grant the census agency full executive authority over the administrative organization of the census. It should also vest full authority over the budget in the census agency. Usually, the funds for a census are allocated in the relevant section of the national budget, in an amount recommended by the census agency. The ideal census budget assigns the agency authority to reallocate resources when unforeseen difficulties arise, especially during enumeration and dissemination. When other agencies are called upon to participate in the census operation, the relevant enactment may also indicate whether or not their expenses are to be borne by the respective agencies themselves.

(e) **Obligations of the public with respect to the census.** The obligation of the public to cooperate in the census operations and give truthful answers is usually provided in the census legislation. Refusal to be interviewed or to furnish the data needed, or giving false information or delaying the submission of returns, can be punishable acts.

(f) **Identification and obligations of enumerators and supervisors.** The identification and obligations of the enumerators and supervisors should be covered in the legislation. Proper identification documents for the field staff are essential to ensure

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the confidentiality of the information and the obligation of the respondent to cooperate. Specific obligations such as recording the responses faithfully and not sharing any individual information can make the enumerators better aware of their functions and make it less likely that they will abuse or neglect them.

(g) **Confidentiality of individual information.** The legislation provisions should also ensure the confidentiality of individual information during enumeration, data processing and dissemination.

2.195   Ideally, the legal framework should allow for a great degree of operational flexibility so as to give the agency conducting the census the ability to continually improve methodologies and deal with problems as they arise. For example, the legal framework can be established to give the census agency the authority to carry out the census and in some cases to choose the topics that have to be incorporated on the census form.

2.196   Willing public cooperation is essential to the successful conduct of a census and will be assisted by non-legislated processes such as a publicity campaign (see chap. II, sect. H). However, there is a need for the census legislation to impose penalties for non-compliance or obstruction. These should be rarely invoked and it would be desirable if offences could be treated using summary procedures and not be subject to lengthy judicial processes.

F.   Census calendar

2.197   Development of a census calendar is crucial step in the planning phase of a census. The calendar or timetable is designed to show the census activities and the amount of time required for undertaking all processes regarding the planning, development and implementation of a census. The calendar indicates the sequence and estimated duration of each of the numerous operations. It is important to prepare the calendar at the early stages of census planning and share with stakeholders in advance for their advice and support.

2.198   A census calendar is essential as a tool for census management and serves as a guide to measure the progress of each stage of the census operation. Serious delays in work or errors in time estimates can be detected. Obviously, the time schedule will differ for each national census depending upon the general census plan and the resources that are available.

2.199   A census calendar shows the list of activities in a hierarchical way starting from census phases,[29] which are usually grouped into three broad sectors: (a) pre-enumeration, (b) enumeration, and (c) post-enumeration. For purposes of control, many operations that in fact overlap are shown separately in the calendar. The calendar should be revised and made more detailed as planning proceeds with the aim of establishing realistic deadlines, including the deadlines for the milestones.

2.200   The time estimation for each activity is a critical process for good management of census operations. Given the fact that the census consists of series of interrelated activities,

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[29] See section B.3 of the present chapter on developing project plans for information about the phases.

preparing the time estimation has to be undertaken in close cooperation with all stakeholders involved in the census operations. At an early stage of planning, the census calendar can be prepared for the main activities; at a later stage, when the elaboration of specific phases and activities takes shape, the calendar needs to become very detailed at the level of tasks to achieve an accurate estimation for completing the census operations.

2.201   Census calendars usually take the form of a diagram showing the sequence, interdependency and timing of all the various steps in the census programme. There are various tools to draw up a comprehensive diagram that can be found on the Internet for download or online use.[30] For example, a Gantt chart is a tool providing a detailed overview of census activities (see chap. II, sect. B.4, above). Census managers need to use such a tool for analysing progress and any delays, which usually have consequences for the timing of subsequent steps in the programme. Regular meetings with all stakeholders are necessary for analysing progress and discussing if there is a need to update the census calendar.

2.202   It is important to use project management software for setting up all of the project activities, tasks and milestones and to show the duration of each task, connect task dependencies, note task assignees, and compare the actual progress against the planned schedule. Census management software should not be sophisticated; the usefulness of such software depends on how soundly it is designed and how easily and efficiently it can be applied and used.

2.203   It is necessary to analyse the actual progress against the planned schedule and its impacts on subsequent tasks. For this purpose, critical path analysis can be a useful instrument for breaking each operation down into activities and tasks, relating each component to the next step in the operation, and establishing the minimum amount of time needed to finish each step and the latest date by which it must be completed in order not to interfere with any part of the operation. Critical path analysis takes account of the operational relationships among the tasks included in the plan. Before critical path analysis can be carried out, each task must be linked both to the tasks that must be completed before it can begin and to those that cannot begin until it is completed. The critical tasks and their sequence throughout the census operation establish what is termed the critical path. Any delay in the tasks along this path will delay the entire census operation unless a compensatory saving of time can be achieved in subsequent tasks along the path.

G.   User consultation

2.204   Ensuring that the needs of users are carefully considered is an essential element of census planning. Since a census is among the largest and most expensive exercises undertaken by a country during peacetime, it is crucial to consult with data users. Such

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[30] For more information, see *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part two, chap. IX, census calendar.

consultation is also a positive public relations undertaking and an efficient, transparent means of determining the demand for potential census topics.

2.205   User consultation has a range of purposes, including selection of census topics and formulation of plans for tabulation and dissemination. However, such consultation will also serve to foster a wider and more informed understanding of the role of statistics in national planning. Strategies for user consultation should be prepared at an early stage of census planning to help understanding its impact on related census activities and the budget.

2.206   There are usually multiple objectives for consulting the data users. The objectives should be developed taking into account the following aspects of census planning:

(a) Confirming the topics covered in the previous census and identifying new data requirements;

(b) Identifying data priorities;

(c) Adapting a range of products and services to meet current and emerging user needs;

(d) Understanding how the census data are used.

2.207   The first step in the user consultation process is to determine the census agency's position on census content. Although the intention of the consultation process is to satisfy user requests as far as practicable, it is necessary to first determine which topics are suitable for inclusion in the census. When assessing potential census topics, the following broad criteria could be used as a guide.

(a) Is the topic of major national importance?

(b) Is there a need for data on the topic for small groups in the population or for small geographical areas?

(c) Is the topic suitable for inclusion in the census?

(d) Are there sufficient resources available to collect and process the data for that topic?

(e) Does it allow for international comparability?

(f) Is it available from some other source already?

(g) Is there a need for comparability with the previous census(es)?

2.208   Once the census agency has determined its position on census content, an information paper can be prepared. The information paper can outline:

(a) The topics planned for inclusion in the forthcoming census;

(b) The topics planned for exclusion from the forthcoming census, with thorough elaboration of the rationale for exclusion;

(c) Other topics, to assess user demand.

2.209   To assess the demand for data on particular topics, a circular should invite submissions from users on what topics should be included in the census. If feasible, the

release of the paper can be supported by seminars held with users. Seminars provide the census agency with the opportunity to meet users of census data and to provide them with an indication of what topics can and cannot be realistically included in the census. It also allows for creating a list of users that can be subsequently maintained and updated throughout the census cycle. In the majority of countries, government ministries and local governments will be the major users of census data, and these seminars provide an opportunity to educate the staff from these institutions about the uses and limitations of census data.

2.210   The second important step in user consultation is to develop strategies for dissemination of census data. The census agency should prepare an information document regarding the plans for dissemination products and services, training that might be needed on the use of the data, and the plans for ensuring confidentiality of individual data and disclosure of information. In addition, plans for the stages and dates of releasing census data should be explained in the document for informing users about these critical dates and for getting feedback from them.

2.211   For successful management of the user consultation process, all steps of this process should be carefully planned as part of the whole census cycle, including the steps for identification of types of users, and selection of methods and tools to be used for consultation (see chap. VI, sect. C, for further information on the user consultation process and the relevant tools).

2.212   Box 8 presents an example from Nepal of strategies that can be employed for user consultation.

Box 8. Strategies for user consultation: Nepal

In Nepal, a wide range of consultations with experts and stakeholders were carried out while designing the census questionnaire and building the concepts and definitions to be used within it. Five national-level seminars and workshops on different thematic areas, five regional-level workshops and 33 district-level seminars were held with a view to obtaining feedback on questionnaires and enumeration manuals. The questionnaires and manuals were revised and peer reviewed by subject matter specialists and gender and social inclusion experts to make the tools more user friendly and inclusive. An emphasis was placed on quality at every stage of census operations, including design of the questionnaires and manuals, standardization of the training of enumerators, monitoring of fieldwork, processing data and tabulation. Continuity between form 1 (complete enumeration) and form 2 (sample enumeration) was maintained in the questionnaire design, which assisted simultaneous data entry and tracing common identification features across the two forms.

H.   Communication and publicity

1.   Introduction

2.213   An effective communication and publicity programme contributes to the overall success of a census. By increasing public understanding of the purposes of the census,

response rates will be improved, enumeration costs per respondent will be reduced, and higher-quality data will be collected.

2.214   An effective communication strategy, including publicity and information campaigns, is very important for those countries where the general public is expected to actively participate in census activities as respondents through either face-to-face interview or self-enumeration, and, possibly, as temporary employees during field enumeration or data processing. In the planning phases of the census, consultation with the public at large is necessary to ensure that all aspects of the census are well understood and accepted. During the operational phase, publicity and information campaigns are usually necessary to inform the public that a census is taking place and also to provide the necessary information to allow and encourage them to participate.

2.215   Special attention is often given to identifying and targeting hard-to-reach population groups in order to ensure consistent levels of response across the country. In essence, the aim of this programme is to engage, educate, explain, encourage, and (if necessary) enforce participation. People living alone, students living away from home and the elderly are among population groups that are generally hard to enumerate during the enumeration period. Other groups that may need to be specifically targeted include the homeless, minorities, immigrant communities and inhabitants of inner cities and dense urban areas.[31]

2.216   There are two main objectives of the communication programme: (a) to inform the public and people involved in the census operations about the census, including the questions proposed to be asked during enumeration; and (b) to provide early and continuing information to the census authorities about the reactions to the census plans and activities of the public in different part of the country, and of key persons, groups and institutions.

2.217   The communication and publicity strategies need to be closely aligned with the collection processes. Important messages about when and how the census is going to be held, who is eligible to be counted at specific locations,[32] what is expected from the public, and how the public can find out more about the census need to be communicated. Public understanding of these aspects of the census will contribute to the smooth conduct of collection operations.

2.218   The size and complexity of a communication programme and publicity campaign will vary according to the conditions in a country and the funds available for such campaigns. The costs of this activity are often overlooked in census planning and it is important that sufficient resources be included in the census budget to ensure a quality outcome. Low-cost

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[31] In some countries there are other population groups that present a specific challenge in terms of obtaining their cooperation, and specific techniques need to be developed for that purpose. For example, in India, households in rented accommodation in urban areas and in "red light districts" are typically difficult to enumerate.

[32] This would refer to tertiary students, for example, as they should be counted at the place of education, not the parents' residence.

communication strategies, utilizing new media platforms, can have a strong impact, even when resources for a publicity campaign may be limited.

2.219   The general communication strategy may be supplemented with a targeted approach to engage with hard-to-count groups. Specific material can be produced to demonstrate the benefits of inclusion in the census for those groups (for example, by demonstrating that the availability of accurate data about them can be used to inform government resource allocation).

2.220   Even though communication programmes and publicity campaigns may vary among countries, the objectives, scope and planning needs of a good programme remain standard for all censuses.

2.221   The planning of effective communication to mass audiences needs to take into account all of the potential issues that might affect the interaction between a census agency and its respondents. Such planning is not easy, and cannot be undertaken at the last minute. Therefore, to deliver successful outcomes the publicity issues need careful consideration in the context of overall census planning. It is essential that publicity planning have the support of the management at the census agency and that it be seen by census agency staff and external audiences as having such support.

2.222   The publicity campaign should also strive to inform key census data users about the availability of census data and its utility. The eventual availability and uses of census data must be included in the pre-enumeration campaign when public attention to the census is maximized.

2.223   Statistical agencies should use professional communication personnel to plan and implement their publicity campaign, thus ensuring that the campaign is professional and attuned to the need to collect high-quality data. This also allows census management to concentrate on the core business of conducting the census. In the early stages of planning, key communication managers from within the statistical agency (where these exist) could be assigned to the census.

2.224   Statistical agencies may also find that the census publicity campaign can be a natural extension of any publicity programmes that are already in place with their respondent and user communities. Such publicity programmes will have developed links with the media and can provide a valuable profile-raising role with the wider community. This can be drawn upon to better generate widespread awareness of a census.

2.225   Box 9 provides an example from South Africa of communication challenges that can be faced when conducting a census.

Box 9. Example of communication challenges: 2011 census in South Africa
A project of the scale of a census will often be interwoven with a country's current cultural, societal and political context. For South Africa, the 2011 census was affected by many of the nation's preoccupations at the time: joblessness and the desire for work, crime and fear of safety of households, and a mainstream media environment often sceptical of government initiatives and intentions. Communication in this context becomes crucial. During the census enumeration, rumours emerged that field staff in different provinces were earning different amounts, and with the advent of social media such rumours gained traction. In the KwaZulu-Natal province, a major newspaper printed an erroneous rate of pay and inadvertently launched strike action by workers. As the organization moved to bring the strike action under control, some workers threatened to destroy questionnaires. Swift action and police intervention brought the situation under control and collection activities resumed. A valuable lesson in ensuring accurate messages was learned. In addition, subsequent projects have started to harness the mass communication power of SMS and social media to keep communication consistent and respond appropriately. *Source:* Statistics South Africa.

2. Developing a communication and publicity strategy

2.226   Before any detailed implementation plans are formulated, a strategy for the communication programme and publicity campaign should be developed. While the situation in each country may vary, the following issues are generally applicable and need to be addressed when developing strategies:

   (a) Background;

   (b) A situation analysis that identifies any particular opportunities or issues that need to be taken into account;

   (c) A clear statement of the objectives of the communication and publicity tasks;

   (d) Definition of the target audiences;

   (e) Statement of messages that are to be communicated;

   (f) New media and Internet penetration;

   (g) Publicity strategies that will be implemented.

2.227   Each of these issues is discussed in the following sections.

2.1   Background

2.228   Census agencies may be aware, from market research or from their own experience, of public attitudes concerning the census. This background can indicate the most likely opportunities and difficulties to be encountered in communicating with the public about the census. It may also reveal particular economic, political or social information and circumstances that may affect how a census publicity programme is perceived or acted upon by the general population.

2.2   *Situation analysis*

2.229   Once the communication environment in which the census is to be conducted has been thoroughly understood and documented, a more detailed analysis of the communication opportunities is required. For example, the census agency may be able to use government-operated mass media outlets, or it may need to ensure access to the mass media through paid advertising for effective publicity. These are referred to as paid media.

2.230   An important part of this analysis is to establish the current opinions of stakeholders about the census. This applies in particular to those stakeholders who are likely to be the target of the publicity campaign. When civil society is receptive to the census, it may be possible to generate earned media coverage. Earned media refers to publicity garnered through means other than directly paying for advertising. It can take the form of panel discussions, interviews and informative new articles. Earned media serves many of the same purposes as paid media, although the statistical agency must be willing to share ownership of the census message with cooperative partners. Agencies need to undertake or commission detailed research, both qualitative and quantitative, into public opinion and awareness of the census. Good research with honest and frank responses about perceptions of the census will provide a strong guide to the way an overall publicity campaign is framed and conducted. The views and beliefs of community leaders and groups should also be canvassed through appropriate forums, which may range from one-on-one meetings to an extensive process of community consultation.

2.231   Changes to the way the census form is worded, the way the census is conducted and processed, and how the output is disseminated have the potential to affect a publicity programme. The impact of these changes on the publicity programme should be considered when such changes are contemplated.

2.232   Attention should be paid to understanding the arguments of individuals or groups who do not approve of the census. At best, this will enable the communication process to seek to change their views, admittedly a difficult task for those who disagree on philosophical grounds. At worst, it will result in a better-planned census that is less likely to be the target of negative reaction by individuals or groups from the community.

2.233   Issues related to privacy and confidentiality may be equally noted in both developed and developing countries, although cultural differences may affect the specific degree of concern.

2.234   As well as this external focus, census agencies should also look inward to the strengths, skills, knowledge and perceptions of their own staff. This process of internal consultation will help to raise awareness of the census and encourage its support within the census agency. The attitude of staff towards the census, and their own individual dedication to a positive outcome, is thus both a management and a communication issue.

2.235   Different communication environments will have their own special challenges. Matters of literacy, ethnicity, politics, geography, access to mass media, including the Internet, and influence of particular beliefs will need to be considered.

2.236   There are wide varieties of potential issues that can affect a census publicity campaign. Identifying them is an important part of the situation analysis. To illustrate, the following issues of importance to members of the public have been identified in some countries:

(a) Privacy and confidentiality of information given;

(b) Whether the information provided was relevant (see chap. I);

(c) Cost of the census;

(d) Potential use of census information for non-statistical or other inappropriate purposes;

(e) Issues raised by lobby groups regarding the inclusion or exclusion of specific topics from the census;

(f) Requirement that name and address be included on the census form;

(g) Concerns about potential government intrusion into private affairs;

(h) Where individuals can find additional information about the census.

2.3   Statement of objectives

2.237   The aim of a communication and publicity programme is to support the operation of the census and obtain a high-quality result through the following measures:

(a) Organizing a recruitment campaign for field staff;

(b) Getting interested groups involved in census planning and gaining their cooperation;

(c) Obtaining information about the reactions to the census plans and activities;

(d) Organizing an awareness campaign to:

- o   Maximize awareness of when the census will be carried out;
- o   Address any issues that need clarification;
- o   Promote awareness of procedures and ways to get assistance;
- o   Encourage respondents to cooperate to the best of their ability.

2.238   The communication task is to provide timely and appropriate information, reinforce positive perceptions and effectively manage any negative issues. Contingency planning should be undertaken to ensure that management of negative issues is effective.

2.4   Defining target audiences

2.239   While the target audience for a census is the population as a whole, for communication purposes this needs to be further analysed and broken down into relevant audience segments. The final set of segments should reflect particular communities of people

in the population that require a particular focus. Experience from previous censuses could be valuable in identifying difficult groups to reach. Such a list should fully answer the question, "To whom do we want to communicate?"

2.240   When possible, the previous census data should be analysed to segment the population for the purpose of formulating communication strategies and messages to target unique segments. The paradata on the timing and method of response, coupled with the socioeconomic characteristics of the respondent, can be used to identify unique segments of the population in order to develop targeted communication to encourage higher rates of participation at lower costs of collection.

2.241   By way of example, a set of audience segments could be the following:

(a) The media;

(b) Opinion leaders and public figures who can endorse the census;

(c) Groups of influential people, such as religious leaders, teachers and unions;

(d) Speakers of the national language;

(e) Speakers of other languages;

(f) Groups underrepresented in previous censuses;

(g) Population groups (such as ethnic groups) with special geographical, social, communication or logistic disadvantages;

(h) Heads of households, if appropriate;

(i) Users of census data;

(j) Staff of the census agency.

2.5   *Statement of messages*

2.242   There are likely to be several core messages that census agencies will need to communicate to their different audiences in order to maximize outcomes for the census.

2.243   Examples of external messages could be the following:

(a) The census is for the good of all because it is the best way to plan for the future.

(b) Filling in the form is a patriotic duty of citizens.

(c) Some resources are distributed to communities on the basis of census counts, therefore being counted helps your community.

(d) The census agency has a human face.

(e) Census enumerators will call at households at certain times.

(f) Assistance is available for those having difficulty filling in their form.

(g) Privacy and confidentiality will be honoured.

(h) The census date will be on _____ and the enumeration will last ____ days.

(i) Cooperation is mandatory.

(j) There are penalties for enumerators or other staff who misuse information.

2.6   New media and Internet penetration

2.244   Messages as presented in the previous paragraph can be disseminated in a number of media. The extensive use of instant messaging – or SMS – on the cellular phone network is well documented worldwide. Hence, the use of this service for dissemination of census advertising – sending to all the subscribers of a specific service provider information about the census – as documented in national practices, has proved to be a useful strategy. Of course, there is a need to ensure that the dispatch of such bulk messages by SMS does not occur at inappropriate times, such as late at night.

2.245   The past decade has seen a rapid increase in the amount of time the average person spends on social media platforms. New media refers to digital content available in an on-demand format, usually through the Internet. It is generally interactive and promotes user dialogue. At the time of publication of the present handbook, examples of widely used new media include blogs, wikis, and social media such as Twitter, Facebook and YouTube. In particular, social media have become important sources of entertainment and information for a substantial part of the global population. Of course, profound regional differences exist in access to the Internet. Differences within the country must also be taken into consideration when choosing the best medium through which to deliver messages tailored to different groups. For the purposes of the population census, establishing a presence on the following new media platforms may prove efficient and useful:

(a) An organization page on Facebook;

(b) A Twitter profile;

(c) A YouTube profile;

(d) An Instagram account.

2.246   Also, consider that the tone of messaging used in new media is often different from traditional sources. The primary objective for the presence of a statistical agency on new media is to gain followers and provide information. Those followers then repeat that information, amplifying and spreading a positive message about the census. While new media are appropriate for publicity around the census, they are probably not the best platform for sharing lengthy technical and legalistic documents relating to the census. In any case, it is essential to respond to questions and issues arising in social media promptly, otherwise their use may be counterproductive. On the other hand, concentrating just on social media and neglecting other, more traditional media, such as radio and television, would risk missing a considerable audience.

2.7   *Publicity strategies*

2.247   Strategies to achieve the publicity objectives should seek to make the census an event of national importance and a topic of public interest and debate.

2.248   Suitable broad strategies could include the following:

(a) Recruiting temporary field staff through advertising;

(b) Staging extensive media events to mark the beginning of the census campaign (formal launch of the campaign), followed up by the issuance of a range of media releases and background material for use by the media for the duration of the enumeration period;

(c) Building awareness through effective media advertising and an active media programme of information dissemination;

(d) Building support through third-party endorsements;

(e) Being proactive in public debates about the census and associated issues;

(f) Developing specific campaigns for each target audience, as discussed above;

(g) Training census agency staff to act as media spokespersons;

(h) Developing lists of expected questions and standard model answers on key issues;

(i) Monitoring the public debate and media coverage;

(j) Raising the awareness among schoolchildren of the census through special programmes, such as a census quiz or census in schools.

2.249   A range of implementation strategies will be needed to put these broad publicity strategies into practice; these are discussed in the next section.

3.   Implementing a publicity strategy

2.250   Implementation strategies or tactics will depend very much on the characteristics of a country's social and administrative mass media culture. Box 10 offers an example from the 2007 census in Ethiopia of the implementation strategies that can be developed for particular audiences. Countries will need to adapt them on the basis of their own particular circumstances.

Box 10. Publicity strategies from the 2007 census in Ethiopia

In 2007, a National Census Publicity and Education Committee was formed consisting of senior level representatives from relevant public and parastatal institutions in the field of communications. The committee had also developed a workplan with timelines and milestones, which were achieved as planned.

- A census logo was developed by an artist and was endorsed by the Central Statistical Agency to give the 2007 census a brand image. The logo showed a couple with children with, as background, a traditional *tukul* and a modern house.

- Public education through radio and television started at the time the pilot census was conducted in 2006 but the intensity of the programme was rather low. The message basically included the objectives of the pilot census; its contribution towards the main census to be carried out in a year; coverage; and type of cooperation expected from households, different levels of public administration and government offices.

- The media are important stakeholders that could effectively disseminate the census message to every corner of the country. A partnership was created with the media through a Media Committee comprising the Ethiopian Radio and Television Agency, Ethiopian News Service, Ethiopian Press Agency, Radio Fana, Walta Information Centre and the Central Statistical Agency.

- A census brochure, produced in Amharic, Afan Oromo, Tigrigna, Afarigna and Somaligna, was widely distributed down to the *kebele* level to be used in local publicity campaigns. Copies were also circulated to donors and schools. Enumerators and supervisors distributed them during the listing exercise conducted a few days prior to enumeration.

- More than 100,000 colour posters prepared in five local languages were printed and distributed down to the *kebele* level. They were displayed at places where people gather, including schools, hospitals, post offices, banks, shops and markets.

- Short songs with census message lyrics and entertaining and educative dramas were broadcast in different languages through radio and television at fixed times and on certain days of the week.

- Several census slogans promoting the importance of participating in the census were disseminated through flyers and broadcast by radio.

Source: Ethiopian Census Plan, 2007, chap. 6.

3.1   *Census agency staff*

(a)   Permanent staff

2.251   Staff of the census agency should be regularly briefed on publicity activities and given previews of advertisements and other material before they are distributed. From a communication point of view, invitations to such briefings could also be extended to the families of staff members.

2.252   Where a staff newspaper exists, it should include regular articles about the census, concentrating on staff involved with particular tasks. A staff video service, broadcast through the organization via an intranet or closed-circuit television, could be used to supplement other contacts.

(b)   Field operations workforce

2.253   The field operations workforce may first encounter the publicity campaign through the recruitment messages used to attract them to the workforce.

2.254   After recruitment, the field staff should be given background information on the publicity campaign so that they are aware of the communication environment that will affect

their work in cases where the supervisor may be involved in distributing some of the publicity.

2.255   It is important that the field staff be given instructions on the procedures for handling requests for media interviews. It is suggested that the communication manager clear all such requests.

3.2   General external audiences

2.256   There will be many opportunities for publicizing the census to external audiences, specific to each country. It is not possible to be prescriptive about these opportunities in view of the wide range of possibilities. Each opportunity should be examined carefully to ensure that it is aligned with the overall publicity campaign message and analysed to ensure a positive cost-benefit ratio. Publicity for external audiences should be greatest just prior to and during the enumeration activity. Some examples of key tactics for general audiences can include the following:

(a) Information booklets;

(b) Media advertising;

(c) Community service announcements;

(d) Engagement of speakers popular with the media and the public;[33]

(e) Posters and pamphlets;

(f) Developing a census logo and slogan;

(g) Influencing key members of target audiences;

(h) New media, such as social media;

(i) Data user conference and technical committee meetings;

(j) Free text messages on mobile phones.

2.257   Each of these tactics is discussed below.

(a)   Information booklets

2.258   Information booklets can be prepared to explain the purposes of the census to households and provide other messages as required by the census agency. Such an approach will be more useful in a self-enumeration approach where interviewers are not present to explain the details to the respondent.

(b)   Media advertising

2.259   Advertisements can be paid for and placed in all forms of mass media, including newspapers, radio and television. The amount of resources devoted to each medium, and the

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[33] Engaging popular sports and cultural personalities to popularize census activities and participation, for example.

details of placement of the advertisements (dates and positioning relative to other elements of the medium), should be selected carefully on the basis of advice from communication professionals within the country.

2.260   Advertisements should be professionally designed and include some audience testing research to ensure the correct message is being transmitted.

(c)   Community service announcements

2.261   In some cases, media interests will recognize the value of the census to the country and supplement paid advertising by free announcements. These could include the following:

   (a) Statements by media staff;

   (b) Use of interesting stories about the census during news bulletins and the like;

   (c) Incorporating a census story in regular programming, such as television serials.

2.262   Access to these opportunities will be greatly facilitated by the use of media releases to keep editors and journalists up to date on what is happening in the census. By cooperating with the media in this way, it is more likely that they will cooperate with the census agency.

(d)   Engagement of speakers popular with the media and the public

2.263   It is important to identify a set of people from within the census agency or other government ministries, or popular personalities with good presentational skills, and where relevant representing various language and population groups, to help to promote census and associated issues through media presentations and interviews. Specific training sessions should be offered to develop and use responses to census issues.

2.264   To ensure that a consistent picture is provided by the spokespersons, they should be given a set of standard answers to expected questions.

(e)   Posters and pamphlets

2.265   In many countries, wall posters and comic books are commonly used as a method of communicating a range of social and general interest messages to the public. Where this is common practice, this medium could be very effective in communicating the census message.

2.266   A supply of posters could be issued to regional managers and supervisors for placement in suitable locations in their areas.

(f)   Developing a census logo and slogan

2.267   Many countries have successfully developed a census logo and slogan. A simple but effective slogan and distinct logo can be developed and used in all national and local advertising campaigns and in all types of media (television, radio, newspapers and posters).

2.268   The slogan can concentrate on explaining why the census is important for the country and why it is important that everyone participate in respect to planning. Examples of simple slogans that have been used include "Let's be counted for Armenia" (Armenia), "You count,

therefore we count" and "Our census, our future" (India), and "Count yourself in" (Canada), which were all examples of slogans used during the 2010 round of censuses. The double meaning of "count" in English and other languages (both "to enumerate" and "to assign worth") is used heavily by many countries (table 5).

Table 5

Examples of publicity slogans for country censuses

Country	Publicity slogan
Albania	I am living in Albania
Armenia	Let's be counted for Armenia
Azerbaijan	Population census is the nationwide activity which serves every citizen of our country
Belarus	Census 2009: it is necessary for me, my family, my country!
Bulgaria	I am part of the census
Canada	Complete the census: it's the law
Croatia	For country is made of people
Cyprus	To know how many we are, what we are, and how we can better organize the future
Czech Republic	The future counts
Estonia	Everyone counts!
France	Population census: each one of us counts
Germany	Census 2011: Germany needs the modern census
Greece	The census begins! We all participate because we all count
Hungary	Respond for the future
India	Our census, our future; You count, therefore we count; Yes we have been counted! Have you?
Ireland	Make your mark with census 2011
Israel	You were selected to influence
Italy	The Italy of the future starts here
Kazakhstan	Everyone is important
Kenya	Count me in
Latvia	Answer for a common future
Lithuania	Where are you?
Luxembourg	We count on you!
Malta	Census 2011: your contribution counts

Poland	Enumerate yourself for the future of Poland
Portugal	Portugal counts with us: we count upon you
Romania	Because everyone counts!
Russian Federation	Everyone is important to Russia!
Serbia	Census is a note for the future
Slovakia	Answers to our future
Spain	Your answer is the most important
Turkey	We are surveying Turkey
United Kingdom	2011 census: help tomorrow take shape
United States	It's in our hands; Ten questions, ten minutes

(g)   Influencing key members of community audiences

2.269   These tactics cover ways in which influential people can be shown the benefits of the census in order to gain their support for the census. They can then encourage other members of their group to support the census. Examples of influential people could include the following:

(a) Politicians (including national and local government politicians);

(b) Village heads or local community leaders;

(c) Religious leaders;

(d) Media commentators;

(e) Senior bureaucrats;

(f) Industry leaders;

(g) Civil society leaders.

2.270   Influential people should be encouraged to provide examples of the ways in which their groups have used the results of previous censuses for the benefit of the community. The overall tactic with influential people is to convince them to endorse the census by talking about it and helping it to become part of community discussion. Inviting them to openings and census events and providing briefing materials are useful ways to keep them involved.

2.271   It may also be possible to seek endorsement from popular figures not included in the above groups, such as sports figures or popular entertainers. It should be noted, however, that such personalities may not be universally popular (for example, a football player may not be liked by the supporters of rival clubs) or they may not be seen as authoritative (for example, what does a singer know about the census?). As with other aspects of the publicity campaign, professional advice should be sought on the implications of selecting such personalities.

(h) New media, such as social media

2.272   In many countries, especially in urban areas, web-based modes of communication can be used to reach target audiences. New media include Facebook, Twitter and blogs. The inclusion of new media in the campaign does not supersede any of the media previously discussed in the present section. Rather, new media should be viewed as an additional point of contact with both the general audience and influential community members.

(i) Data user conference and technical committee meetings

2.273   The community of data users in a country provides a natural group of advocates to be engaged by the statistical organization. The primary purpose of the data user conference, a seminar sponsored by the statistical organization, is to solicit feedback and obtain buy-in concerning questionnaire content. However, data users and members of technical committees can be asked to contribute to the publicity campaign also. A high-level data users' community can help to spread the message about the importance and utility of the census within their organizations and possibly through their networks of contacts. The communication strategy should be well formulated before engaging deeply with the data users' community so that a consistent message can be delivered.

(j) Free text messaging on mobile phones

2.274   The usage of mobile phones is increasing dramatically in many countries around the world. Collaboration with telecommunications companies to spread messages related to the census may be an effective and relatively inexpensive way to target the messaging at an individual level. It is of utmost importance to ensure that these bulk text messages are free to the receiver and that the fact that it is free is also known in advance. The publicity campaign should identify specific times and develop specific messages to be distributed. For instance, a pre-enumeration message could alert people to the impending census date. Another message could be sent on the day enumeration starts to remind people that enumerators will be visiting their homes. If any special events or programmes are being organized to celebrate the census, a message about that may be appropriate to send to mobile phone users.

2.275   Box 11 presents an example from Kenya of publicity and advocacy activities related to the 2009 population and housing census.

Box 11. Publicity and advocacy in the 2009 population and housing census in Kenya

The publicity and advocacy campaign for the 2009 population and housing census was commissioned to a private media agency by the Kenya National Bureau of Statistics in response to efforts from various lobby groups for the exclusion of the ethnic question from the census. This opposition threatened to derail the entire exercise by shifting attention away from educating and building confidence in the public to participate in the census, to concerns about how the information would be used.

An awareness creation campaign through various channels started early in the census implementation process and was sustained throughout the census exercise. The public information

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campaign was designed to position the census as an important national exercise, undertaken within international guidelines, and it mobilized support from key influential groups. This resulted in 98 per cent of Kenya's 12 million households participating in the survey, the highest rate since independence in 1963.

Among its many initiatives, the campaign proactively engaged faith-based organizations, in particular Christian and Muslim groups. These groups agreed to disseminate the census publicity materials to their congregations countrywide and to make announcements asking people to participate in the census on the three consecutive Sundays and Fridays before the exercise.

A major thread running through the campaign, which helped to ensure its success in presenting the census as a unifying national force, was its logo. The three design elements in the logo represent a household: black for the man, green for the woman and red for the child, who are all reaching out to be counted as Kenyans. The slogan underlining the logo was in the national language of Kiswahili – "Nipo! Natambulika!" – which in English translates to "Count me in".

The media relations campaign was so effective that the Kenya National Bureau of Statistics was chosen for the 2010 United Nations Grand Award for outstanding achievement in public relations.

Source: United Nations News Centre, 2010.

3.3   *Specific audience tactics*

2.276   There may be specific audiences that require particular attention, and different tactics, when implementing the publicity campaign. Examples of these audiences may include:

(a) Different ethnic groups within the community;

(b) People travelling within the country on the census day;

(c) Overseas visitors;

(d) The homeless;

(e) Nomads;

(f) Immigrants;

(g) Persons with disabilities.

2.277   The differing cultural backgrounds of some ethnic groups within the community may require different strategies to ensure that the messages are communicated effectively to members of such groups. Persuading the leaders of these groups that the results of the census are important to the groups is often an effective strategy because of their influence and prestige. One strong message for persuading ethnic groups to participate is to point out that some government resources are distributed according to census counts. Placing advertisements and editorial commentary in specialized media outlets (for example, ethnic newspapers) is also an effective means of communicating with such groups. Other means could include distributing pamphlets and information sheets in the different languages of ethnic groups.

2.278   People who are travelling on the census day are frequently difficult to contact. Publicity campaigns targeting this population may help to overcome the challenges that they present.

2.279   In many cases, there is doubt in the minds of people who have recently arrived from overseas about their participation in a census. Such doubts can be overcome by using announcements on international flights close to census day to explain the census to these people. This opportunity can also be used to communicate with residents of the country returning from overseas who might otherwise not be influenced by the publicity campaign. Information pamphlets in different languages can also be distributed to hotels and motels.

2.280   It is possible to focus on events for specific groups who are difficult to reach, such as the nomads and homeless. A number of countries use the availability of subsidized food outlets to reach out to people without a fixed address. This could be a soup kitchen operated by charitable groups or a special event (for example, a breakfast for homeless people on census day).

3.4   Census education in schools

2.281   Schools can provide a good opportunity for getting the message into a large number of households by providing the teachers with resource materials to enable them to give a class on the census close to census day. The objective of such an exercise is to provide the message to the children so that they can pass it on to their parents, who will be responsible for completing the form or giving the interview. A key issue with such endeavours is that the material must be provided at the correct time of year so that teachers are able to incorporate the material into their planning.

2.282   Lower primary school children may not relate well to census concepts, and efforts could be better focused on upper primary or secondary students.[34]

2.283   Box 12 presents an example from South Africa on the link between the census and education, while box 13 gives information on the Integrated Communication Plan for the 2010 census of the United States of America.

Box 12. Learners in census communication: 2011 census in South Africa

Educate a child, and you educate a nation. Learners and educators are crucial communication partners, constituting a strategic investment in the future. In South Africa, the Census @ School project was launched in 2001 by Statistics South Africa. It focused on data handling methods by which learners gathered basic information about themselves, and raising awareness of the census count. During the 2011 census, Statistics South Africa sought to leverage this platform during both enumeration and dissemination. Learners were engaged in the Learner Ambassador Programme to mobilize both learners and teachers to ensure that every household in the country was counted in the census. The initiative encouraged learners to take the census message back to their dwellings.

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[34] See the United States 2010 Census in Schools Program, available at http://www.scholastic.com/census/.

Following the census, learners were taught how to access the census data for topical information of relevance to the developmental context of their local municipalities.

Source: Statistics South Africa.

Box 13. Integrated Communications Program for the 2010 census in the United States

The Integrated Communications Program for the 2010 census was one of the most extensive and far-reaching marketing campaigns ever conducted in the United States. For every 1 per cent of households that mailed back the census forms, the Government saved US$ 75 million in enumeration costs. Therefore the ability of the campaign to achieve its objectives was critical not only for ensuring an accurate count of the population as mandated by the Constitution, but also for achieving significant cost savings.

To ensure that everyone was reached with relevant information, campaign materials were produced in 14 languages – English, Spanish, Mandarin, Cantonese, Tagalog/Taglish, Vietnamese, Korean, Japanese, Khmer, Hindi/Hinglish, Arabic, Russian, Polish and French Creole.

For the first time ever, the 2000 census had used paid media along with public relations, promotions and partnerships. That effort had been highly successful, reversing decades of declining participation. The 2010 campaign learned extensively from that campaign and incorporated lessons from it, including the continued use of paid media.

The campaign was fully based on research. Every element of the campaign was researched among its intended target audiences to ensure effectiveness before it was deployed in the marketplace. Each piece of promotional material was based on validated communication strategies, ensuring that the overall intended message was clear, compelling and persuasive and, importantly, was not viewed negatively by other groups that might see or hear it. Research was conducted in languages, as needed.

The Integrated Communications Program involved many of the strategies discussed in the present section. The strategy was driven by considering how best to "ignite conversation" across the entire spectrum of United States society.

Source: 2010 census Integrated Communications Program, United States Census Bureau.
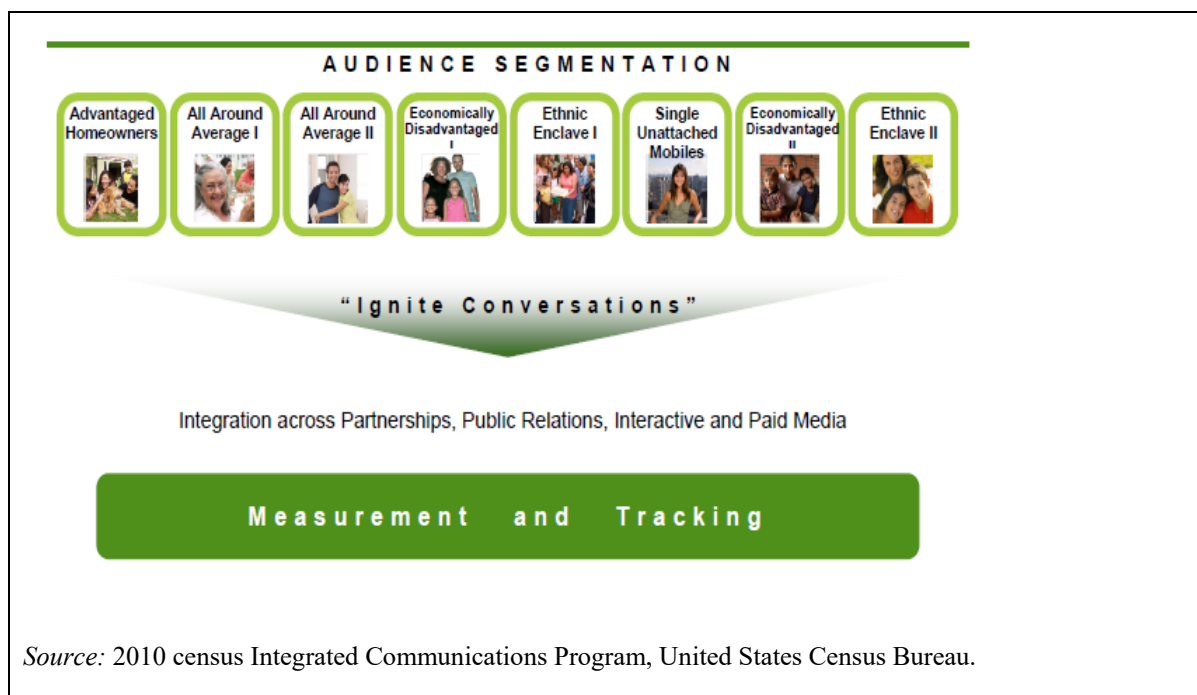
4.   Publicity support services

2.284   To support field operations, many countries have established publicity support services to help in publicizing the census and assisting the public. The implementation of such services will depend largely on the infrastructure available within the country. While the examples given below may not have been applicable to many developing countries in the past, they are now rapidly becoming viable in a number of countries. Three examples of such services are:

(a) Establishing a census web page on the census agency's website;

(b) Providing a telephone-based enquiry service;

(c) Monitoring new media accounts for respondent enquiries.

4.1   Census web page

2.285   The numbers of people accessing the Internet has increased dramatically in recent years. While the largest increase has been in developed countries, the number of people now accessing the Internet in developing countries is increasing rapidly and will further increase in the coming years. Many people in the developing world access the Internet exclusively through their mobile devices. The method of access to the Internet, either through mobile or desktop computing, influences the user experience. The Internet content should be developed cognizant of these differences.

2.286   In that context, it is necessary to take into consideration the fact that more and more people accessing government services are using the Internet. Consequently, census advertising banners should be displayed on all government web pages frequented for

provision of different services, such as issuing driver licences, health services and social services. As a number of these services would be delivered by subnational government authorities, the campaign for attaching the banners to all of them would require timely preparation.

2.287 Statistical agencies, almost without exception, develop their own web pages and can use these to publicize the census, or they can also (and preferably) create a dedicated web page for the census. All material that is included in other forms of advertising can be placed on the web page. To ensure the consistency of information disseminated through different channels, it is desirable to share online all material related to the census organization, census legislation, laws on protection of personal data and respondents' guides. Commonly asked questions about the census and answers can also be placed on the web page. These can be updated continuously as the agency become aware of issues raised by the public.

4.2 Telephone enquiry service

2.288 The telephone enquiry service provides a system whereby members of the public can obtain assistance with particular questions on the census form, ask questions about the census or report issues in the field. This service is often referred to as a hotline. The service must communicate the same messages as the overall census communication campaign; therefore, it is appropriate to include it in this chapter. The service should be, as a rule, free of charge.

2.289 Where possible, assistance should be available to callers in all the languages commonly spoken in the country. This may require the assistance of telephone-based interpreters. The hotline service may also assist speech- and hearing-impaired members of the public by the use of fax and touch telephone facilities.

2.290 Where matters raised over the hotline require action by enumeration staff (for example, a household has not been enumerated several days after the census day), the hotline staff may interact with other communication procedures to raise these matters with appropriate field staff.

2.291 If the self-enumeration method is used, a hotline can provide instructions on particular census questions or enumeration and response instructions. If interviewers are used, a hotline may serve to validate the presence of the interviewers or as a mechanism for reporting inappropriate behaviour by the interviewer.

2.292 People who are familiar with telephone services will not hesitate to use the facilities to seek information. This can lead to a considerable demand for the service and it is unlikely that the census agency will have the expertise to provide the necessary services in house. The assistance of the country's telephone service providers will be essential to provide the service. This could take the form of a formal contract outsourcing the service.

(a) Strategies

2.293 The hotline can be either centralized or decentralized. The advantages of a centralized hotline are as follows:

(a) Provides a higher probability of standard responses to callers;

(b) Provides economies of scale to a potentially large undertaking;

(c) Releases regional management staff from the burden of administering and managing a hotline;

(d) Offers more efficient and effective training of operators.

2.294   The benefits of a decentralized hotline are the following:

(a) Spreads the network demand over a greater number of sites, reducing the likelihood of localized system overload;

(b) Increases the likelihood of operators being able to respond to issues specific to a locality.

2.295   The disadvantages of each approach are the opposite of the advantages of the other. While each country should make a judgement about the balance of views, it is suggested that the benefits of standard answers to questions and economies of scale are important arguments for centralizing the process.

2.296   As with all other aspects of the census, this element of the undertaking should be subject to testing. In particular, it should be subject to load testing to ensure that the telecommunications system can operate under the estimated peak loads. To the extent possible, this testing should simulate the types of queries raised in the census and come from all regions of the country.

2.297   Where a hotline service is offered, it should generally be widely advertised. It is thus the responsibility of the census agency to ensure that as far as possible all calls are answered. An important fallback option is to have the capacity to add extra sites to the hotline where the demand is too high for the established sites.

2.298   It may be possible to provide this emergency service by diverting a proportion of calls to the permanent offices of the census agency. Such outcomes are not desirable as they will affect other work in the census agency and require the use of untrained staff, thus negating a key benefit of the centralized approach.

2.299   The hotline should operate for the entire period that enumerators are on duty, and preferably for a few days afterwards (since a number of calls towards the end of the period will concern non-contact by enumerators). In a self-enumeration census, many people will complete the census form in the evening. It is therefore important that the hotline be open at that time to answer questions at the time when they are being raised. Different time zones within a country also need to be taken into account.

(b)   Staffing and training

2.300   It is necessary to have sufficient staff engaged, either by the census agency or by the contractor, to meet the expected demand, and to have some reserves trained to assist in dealing with unexpected peak demands.

2.301   The majority of staff will be temporary employees who will provide standard answers to the most common questions expected to be asked. These will cover matters such as the meaning of the questions on the form and simple procedural matters (for example, "When will the enumerator be arriving at our dwelling?"). While the answers to most questions handled by the staff will be straightforward, the ability to deliver these answers in an efficient and polite manner is an acquired skill. Where possible, it is desirable to use staff that have experience from other hotlines or telemarketing campaigns.

2.302   There will also be a number of difficult calls involving either more concerned or aggressive callers or more complex topics. The census agency should provide expert staff to answer such calls, regardless of whether the hotline is undertaken by the agency or outsourced.

2.303   Training provided to hotline operators should cover basic conditions of work and telephone techniques, and census knowledge and specific enquiries.

2.304   Hands-on training prior to logging in for the operator's initial shift can be considered a useful approach. It would allow the reinforcement of techniques and the transmitting of news about recent developments in the census.

(c)   Managing demand

2.305   Managing the demand on the hotline is a primary consideration that needs to be looked at when designing the hotline for a census. In most countries, it will not be logistically possible for any call centre, regardless of how well resourced and planned, to cope with the huge number of calls that may be received if the census becomes a topic of major public debate. The task is to manage the demand on the hotline in the first instance.

2.306   Some specific recommendations for reducing demand are the following.

   (a)   A short information booklet can be produced and distributed containing straightforward and convincing answers for householders who are concerned about the compulsory nature of the census, confidentiality and privacy.

   (b) Such an information booklet should include standard responses to queries about common procedural matters, such as dates of the collection period and what response should be given by people who are away from home at census reference time.

   (c) The preceding topics should also be explained in the general census publicity and be further reinforced by the enumerator at delivery.

2.307   The hotline can be an essential component of census operations and provide an important service to the public. It can also play an important role in assuring the public of the need for the census and that confidentiality and privacy are assured.

(d)   Link to control systems

2.308   A telephone enquiry service may also be linked to the operational control system for the census. Such a link requires specialized software linking the enumeration control database

to the calls made by individual operators. The software must be designed to ensure that a household enumerated via the call centre is removed from the queue for field enumeration. A properly designed call centre can be used to:

(a) Confirm data collection during pre-enumeration operations (for example, household head name, whether household will participate in Internet-based data collection);

(b) Check data collected during the enumeration;

(c) Perform phone enumeration for non-contact households.

4.3 *New media monitoring*

2.309 New media accounts provide a hybrid means of communication that combines the information dissemination capabilities of a website with the possibilities for respondent feedback discussed in the previous section on a telephone call centre. Material used for the census website can be reused on social media pages. These materials can be spaced out to provide a continuous stream of content, especially as the census date approaches.

2.310 Monitoring and responding to comments made by the public on new media pages can be a delicate and challenging task. As with staffing the call centre, the job can be outsourced or staffed by in-house personnel who have received specialized training.

5. Budget

2.311 The budget for the publicity campaign will vary with each campaign. Important factors to consider include the frequency of the census, the quantity and quality of publicity activities by the census agency between censuses, resources that can be called upon at subsidized or free rates (for example government-owned media outlets) and the size of the population. Many communication strategies can be implemented on a limited budget. Commercial stakeholders that make use of census data may offer their communication channels to publicize the census. Be creative when working with a limited communication and publicity budget. Ideas for free or nearly free communication outlets include the following.

(a) Mobile communication companies can send free texts reminding subscribers of the census date and the importance of the census.

(b) Members of religious hierarchies can spread the census message during services leading up to the census date.

(c) Utility companies can print a reminder of the census date on utility bills.

2.312 Investment in good communication can have a real and positive impact on response rates and on the quality of data from the census. It is important to recognize this when setting the draft budget. It is suggested that the determination of the final budget is best undertaken after early planning has been done (including initial market research), as there will then be a better basis on which to seek endorsement from census agency management. This additional

information will also be of value in setting broad parameters for briefing advertising and communication agencies.

6. Evaluation

2.313   The evaluation of a publicity campaign needs to be approached and planned as a continuous process from the beginning of the campaign leading up to an overall evaluation.

2.314   A suggested basis of a good publicity evaluation approach is as follows:

(a) To have established objectives that are measurable;

(b) To measure the media exposure;

(c) To measure its impact on the intended audience;

(d) To measure perception of the publicity campaign through social media.

2.315   Measuring media exposure could include indicators such as total coverage or broadcast time given to the messages. Measuring the impact would include the ability to track swings in public awareness (positive, negative or neutral), its relativity to the message being communicated, and the ratio of audience reach to frequency of the message.

2.316   Internal feedback, especially that noted or received by the communication unit and by field staff, is useful. In organizing the feedback reports, a universal methodology needs to be put in place beforehand, as well as protocols for triggering remedial procedures based on the feedback.

2.317   Continuous evaluation and modification during the census enumeration process through tracking research and dynamic management will ensure that implementation of the publicity campaign is on the right track. To permit this to occur, flexible implementation tactics are essential in order to maximize outcomes.

2.318   In setting up systems to evaluate communication efforts, it is appropriate to take a long-term view and ensure that measurement of awareness can continue throughout the intercensal period, and that the methodology is such that comparison between censuses is possible.

2.319   The results of this detailed evaluation of the publicity campaign need to be considered as part of the overall census evaluation, and judgements made about what can be improved in the future. Evaluation of the publicity campaign must be seen as credible if its vital role in a successful census is to be appreciated and understood.

I. Financial management

1. Financial basis

2.320   Censuses are usually one of the largest and the most expensive statistical activities that Governments and their national statistical offices undertake. Many countries have a difficult time raising adequate funding to conduct the census in a timely manner. While

ideally a Government should bear the costs entirely, in some countries, the donor community becomes an important source of resources.[35] There is pressure on national statistical offices to use the most cost-effective strategies for conducting census operations.

2.321   Statistical agencies should ensure that resources are effectively used while planning the census methods and technology. There is no standard methodology for achieving effective and efficient use of resources; however, the following issues can be taken into account for ensuring cost-effectiveness:[36]

   (a) Adopting more efficient and effective data collection, data capture and data-processing approaches and related technology;

   (b) Contracting out appropriate parts of the operation;

   (c) Exploring possible sources of alternative funding and, if appropriate, developing proposals for cost recovery and income generation;

   (d) International collaboration and reuse of systems;

   (e) Encouraging the public to self-complete forms online or on paper where possible;

   (f) Replacing direct collection of data with use of administrative registers, if registers are reliable.

2.322   Planning the census as inexpensively as possible without compromising quality requires carrying out cost-benefit analysis by estimating the strengths and weaknesses of alternative approaches regarding the methods and technology that satisfy the objectives of the census. With this kind of analysis, it would be possible to determine options that provide the best approach for ensuring cost-effectiveness. This will also provide a basis for comparing alternative approaches, which involves comparing the total expected costs of each operation against the total expected benefits, to see whether the benefits outweigh the costs and by how much.

2.323   Box 14 presents an example from Ethiopia of carrying out a cost-benefit analysis for conducting a digital census.

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[35] The following is stated in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paragraph 2.75: "It should be emphasized, however, that censuses cannot be carried out merely by national statistical and census offices alone. Rather, conducting a census should be seen as a national task involving all stakeholders. Thus, government departments, non-governmental organizations and private sector end users should be consulted at all stages to ensure the legitimacy of and need for conducting the census and, at the same time, to improve advocacy for sufficient funding."

[36] For more information, see *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 2.11–2.14.

Box 14. Cost-benefit analysis for conducting a digital census: Ethiopian case

The Central Statistical Agency of Ethiopia is in the process of preparations for the fourth population and housing census. The census results are eagerly awaited by Government and the private sector for informed decision-making. To cater to the demands for timely census data, the Central Statistical Agency is contemplating conducting a digital census. The tables below provide a summary of the cost and benefit assessment prepared to aid decision-making. Reflecting the situation existing in the country at the time of drawing up census plans, the first table presents information on estimated direct costs and benefits while the second table provides information on indirect costs and benefits of paper-based and digital censuses.

Estimated direct costs for scanning and digital data capture for a population and housing census in Ethiopia (US$)

Cost components	Scanners	Handheld devices	Remarks
Capital cost of software and hardware	3,798,000	28,000,000	140,000 tailor-made devices
Printing scannable questionnaires	3,783,000	–	Printing questionnaires, manuals
Vendor support costs	1,142,000	130,000	Local and international consultants/firms
3G dongles	–	2,300,000	46,000 dongles; one per supervisor
Telephone and Internet airtime	74,000	460,000	Flat fee of US$ 10 per device
Salary of processors needed	2,187,000	200,000	Staff training, salary and allowance
Payment for enumerators and supervisors	26,000,000	17,300,000	Daily subsistence allowance
Stationery, bags, etc. for enumerators	2,057,000	–	
Transport/freight cost	392,000	120,000	Distribution and collection
Storage and documentation	955,000	250,000	
Total	**40,388,000**	**48,760,000**	

Indirect advantages and disadvantages of paper-based and digital census: the case of Ethiopia

Items	Paper-based census	Digital census
Data receiving, processing and storage space	Space-intensive: large space required for the storage of material and for the efficient flow of forms throughout the processing stage to reduce bottlenecks	Efficient: minimal space requirement
Suitable access for transport to deliver the forms or devices	Had proved to be difficult in 2007 census as processing was centralized at headquarters where large volumes of materials were processed	With care, devices can be easily distributed and collected
Length of storage period required	Perhaps up to 10 years or the next census	Relatively short because as it will be used in other statistical operations, or all or some of it will be sold and rented out
Security for storage	Not easy to manage, in particular after data capture	Devices can be made traceable
Estimated time for data collection	Two months	Return of all raw data to headquarters: one week
Estimated time for first tabulations after data collection is completed	Five months	One month
Quality of data produced with built-in validity check of data	Satisfactory	Better quality
Labour requirement	Labour intensive: requires more labour packing, loading and unloading materials and papers at each stage	Relative labour requirement much less

Source: Project document of the 2017 population and housing census, Central Statistical Agency of Ethiopia.

Note: Cost estimates are based on the project document of the population and housing census prepared in 2017.

2.   Budget and cost control

2.324   The total budget for census operations needs to be established early to enable other planning to go forward. The census is highly cyclical, with resource requirements peaking in the enumeration and processing years (see section B.1 above). Also, countries with short census cycles (such as five-year intervals) may have some phases (for example, evaluation of the current census and planning for the next one) overlapping in some years, and resources will need to be allocated from different census budgets.

2.325   An example of a census budget cycle is illustrated in figure VI. In this particular example, the census is held in 2020/21, with peak expenditure mainly comprising salary costs for enumerators and data processors. The increase in the previous year is mainly attributable to the cost of printing census forms and equipment purchases. However, it should be noted that there is continuing expenditure in the other years to cater for the planning, preparatory and dissemination phases.

2.326   In developing a census budget, sufficient resources need to be allocated to each of the different phases (planning, mapping, questionnaire development, publicity, field operations, processing, dissemination and evaluation). Funds allocated and used in an effective manner on planning and preparation will result in savings in efficient enumeration and processing operations. The resource needs of the dissemination phase should be realistically assessed and quarantined from the impacts of other census operations. Whatever may have been the effectiveness of the enumeration and processing operations, the users will judge the census on the ability to deliver the data. Failure to deliver census data on time and in the way desired by users will reflect on the census programme as a whole.

2.327   There are various ways of estimating budgets:

   (a) Budgets may be based on the same allocations received for the previous census, brought up to current prices by adjusting for inflators for increased costs (such as salary increases), deflators for efficiency gains (such as implementation of new technology), policy changes, or population increases.

   (b) Budgets may be based on the previous expenditure pattern, again adjusted as above.

   (c) Budgets may be zero based using costing models to establish the requirements for each of the phases.

2.328   Usually, the largest component of the census budget is salary costs. Costs for field enumerators and data-processing staff make up a significant proportion of the overall salary costs. Therefore, special attention should be given when calculating the salary costs associated with these two activities. The methods for calculating these costs are covered in more detail in chapter III, section F. Once the budget has been established, funds should be allocated to particular financial years in the census cycle. This should then be broken down into the different projects within the overall census programme (such as planning, enumeration and processing) and itemized showing the various categories of expenditure. It has to be emphasized that there are significant differences in budgeting for a paper-based

census, which would require considerable budgeting for printing, distributing and collecting the forms compared with a non-paper census. Figure VI provides an example of a paper-based census – however, in reality, the curve might differ significantly depending on the method and technology used for data processing.

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Figure VI

Census budget cycle: example of expected expenditure patterns
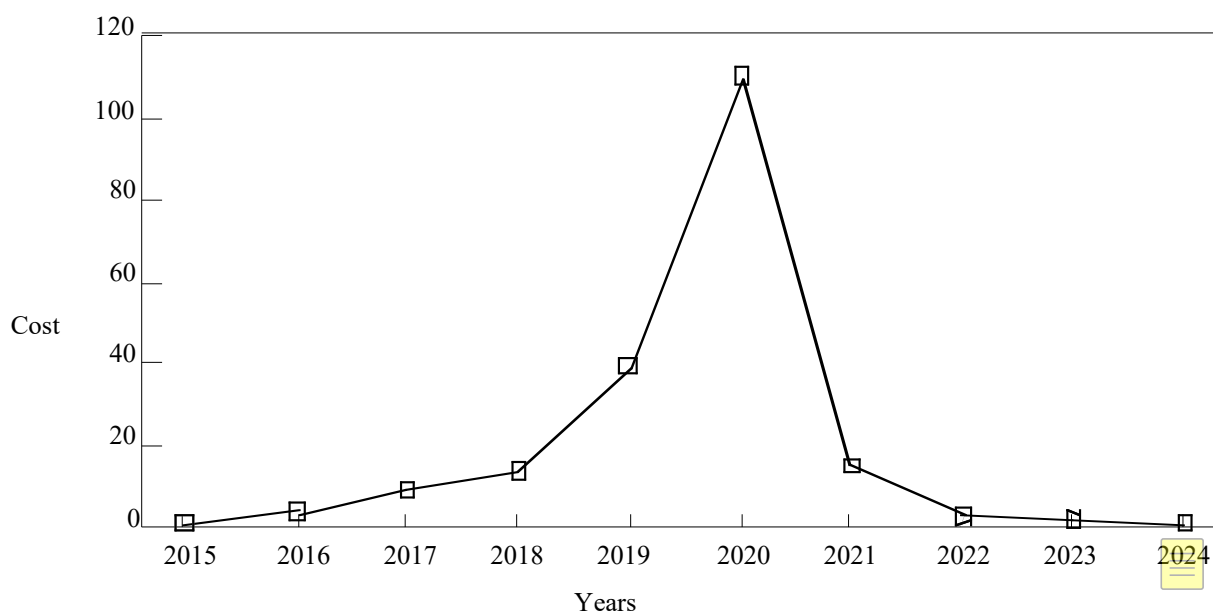
2.329   Once funding is received, it is necessary to monitor expenditure against funding for the current and future years. While budgets may be compiled on a yearly basis, they need to be monitored on a quarterly or even a monthly basis, with projections of the total expenditure for the current financial year. Each phase's performance should be monitored against budgeted funds. Monthly reports should be produced for each phase, showing the annual budget, expenditure to date and estimates of expenditure for the rest of the current financial year and future years in the census cycle.

2.330   Although monthly monitoring of costs to budget is a reasonable approach for many activities of a census programme, a more frequent monitoring of costs should be implemented for large-cost activities that have a very short duration. This is the case in particular for the field enumeration activity, which usually occurs over a short period and is one of the largest single cost activities incurred within a census of population. In this case, daily monitoring of costs against budget, as well as output (for example, completed questionnaires), is important in order that financial resources are expended to ensure the best possible results (high and equal quality of coverage, and timeliness).

2.331   It is important that a process of estimating expenditure in future years be undertaken on a regular basis. This provides the forum for the project managers to review plans for the current and future years of the cycle and to bid for changes to resource levels.

2.332   Forward estimates would need to be prepared and reviewed on a yearly basis for all years of the census cycle and submitted to the project board for consideration. When preparing forward estimates, project leaders should review projected expenditure thoroughly and provide full justification for any variations they are seeking.

2.333   The forward estimates process can provide the facility where:

(a) Managers can bid for increases or indicate savings in resources over time, or reallocate expenditure between different financial years or items;

(b) Bids can be considered by senior census management, taking all bids for all years into account at one time.

2.334   The estimates provide a formal mechanism for senior management to be aware of shortfalls in funding or surplus funding and for management to consider any significant changes in planned resource use. Table 6 gives a categorized example of the items that can be included in a census budget. Not included in the table is the contingency budget, which would need to be also prepared in line with the risk management planning and strategies for mitigating the consequences of accidental events (see chap. II, sect. B. 3.6, above). Also, the table does not fully reflect the specific budgeting for a census using portable electronic devices for census enumeration – while a number of budget items would overlap irrespective of the enumeration instruments, there would still be significant differences for acquiring such devices, developing and uploading applications, developing protocols for data transmission and so forth.

Table 6

Examples of items included in a census budget

Category	Items
Capacity development	Training, workshops Production of training aides (such as videos) Consultancy (short or long term) Study visits
Census maps	Satellite imagery Software Hardware System development and maintenance Salaries for temporary field staff
Equipment	Handheld devices Portable devices Software licences Installation of hardware Computers, data storage media Printers, photocopiers, telephones, fax machines

	Generators
	Scanners (where the census is paper based)
Testing	Pilot census
Stationery	Satchels
	Pens
	Folders
	Clipboards
Vehicles	Purchase of cars, motorboats, or other transport
	Rent of vehicles
Questionnaire development	Design (including testing)
	Application for handheld devices, if using electronic questionnaires
Printing	Census maps
	Census questionnaires and manuals
	Training materials
	Publicity materials
	Census ID cards and other materials
	Stickers and other forms
Communication and publicity	Meetings and workshops
	Design of publicity materials (posters, pamphlets, videos)
	Advertisement and publicity in mass and digital media
Logistics	Packing and delivery of census materials and equipment
	Storage of census questionnaires, maps and materials
	Office lease
	Data-processing centres (renovation or upgrade of civil and electrical works)
	Office furniture
	Office running costs (electricity, fuel, cleaning)
	Telephone and postage charges
	Security, including costs associated with securing census forms and data
Salaries for temporary field staff (enumeration and data processing)	Enumerators, supervisors, data processors
	Staff of regional offices
	Allowances for overtime or superannuating payments
	Others
Travel	Tickets
	Per diem
	Other expenditure related to travel of census personnel
Dissemination	Web dissemination system development, hosting and maintenance
	Printing of publications
	Development costs for census output products
	Promotional activities, including national and regional workshops
Other	Any applicable government taxes

	Construction costs, if special facilities are required for hosting operations

2.335   In the majority of countries, the largest costs in the census are those associated with the enumeration activity and salary for data-processing staff. figure VII shows the approximate breakdown of costs by major item. This breakdown will vary between countries and depends on such factors as labour costs, but is included to give managers an indication of what the major cost items are.

Figure VII

Average cost breakdown (percentage of total expenditure) in ECE countries that conducted a traditional census
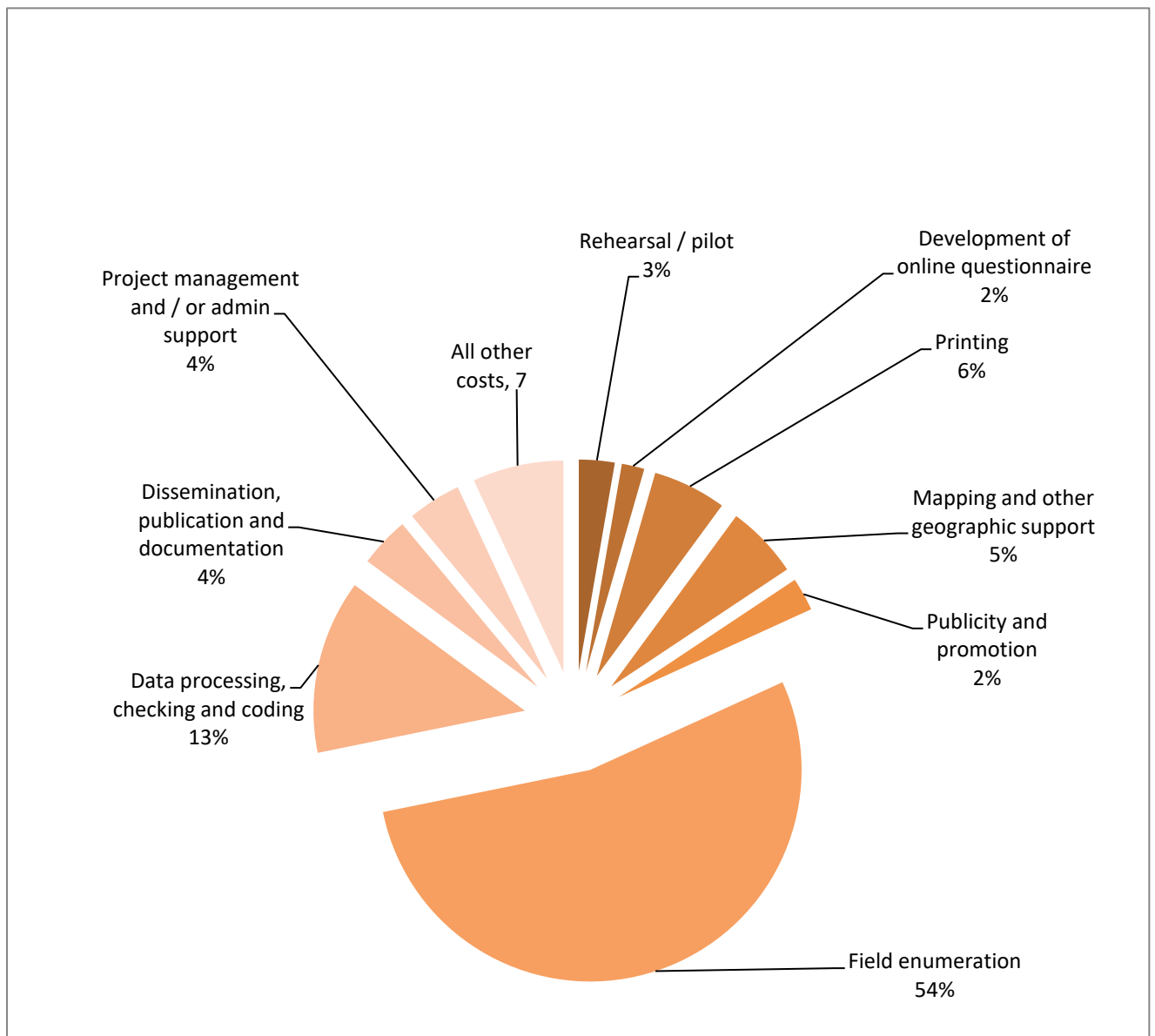
Source: *Measuring Population and Housing: Practices of ECE Countries in the 2010 Round of Censuses*, Economic Commission for Europe, 2014.

J.   Procurement

2.336   Proper procurement and logistics planning is essential for successful implementation of a census. When preparing for a series of census operations, it is necessary to develop appropriate plans for the procurement of all types of goods and services in cooperation with all counterparts. Procurement process can be complicated and may take a longer time than expected, as procurement of the many items required for census operations would not be the usual activity of a statistical agency; it therefore requires careful planning in order to avoid last-minute action and unnecessary improvisation.

2.337   Procurement of goods and services for conducting a census is a process requiring the following steps.

(a) **Needs assessment.** The needs of the census operation are assessed, including precise explanations of the required specifications. This step should also describe when and where the goods and services will be required and for how long. A needs assessment and comparative study of providers should be done for every item of goods and services, which may require different procurement processes.

(b) **Cost estimation.** Estimation of the costs of each item and service should be undertaken in a way that realizes the best value for money, which requires searching for an optimal combination of technical and financial factors. A balance between price and performance under the specified criteria should be taken as the principle for ensuring the cost-effectiveness of this process. Cost estimation can be a challenge, in particular for new technology, given that countries often use estimates from past censuses.

(c) **Developing clear procedures.** Procurement procedures for national and international procurement vary between countries and should be developed according to national requirements and rules. Proper management of this process is critical. An activity plan including all procedures, counterparts and their duties, and the timing of each activity, should be developed and monitored by the manager of this process.

(d) **Determining specifications.** Specifications and minimum requirements for all goods and services will be prepared in collaboration with the related census teams. This step usually takes a long time as it requires good technical knowledge as well as familiarity with the options available in the market. This process should therefore be allocated sufficient time, taking into consideration all the steps needed for final approval of the specifications.

(e) **Determining evaluation criteria.** Criteria for evaluation of the proposals are critical for successful implementation of the procurement process. Principles for determining evaluation criteria usually vary between countries, but it is important that the

proposals related to technical specifications be evaluated in a way that ensures value for money.

    (f) **Application of official procedures for the tender.** This step will be implemented according to the national system, which can vary significantly between countries. However, two main principles of procurement – fairness and transparency[37] – should be adhered to, as well as adequate procedures for capacity assessment.[38]

    (g) **Contingency planning.** Equally important is contingency planning, as certain products and services may appear to meet initial specifications only to fail during testing.

2.338   Procurement activities should be planned and implemented by a specifically assigned team, and the timetable of these activities should be integrated into the census calendar. The time schedule for procurement activities is important and should be planned taking into account possible risks of delay in the provision of goods and services. A significant delay in the procurement process will jeopardize the accomplishment of the milestones and may result in a need to change the date of enumeration or dissemination.

K.   Contracting out

2.339   National statistical offices may need to contract out some of the tasks during a census operation in the interest of efficiency, as in-house expertise may be lacking. Commonly contracted out tasks include layout and printing of census questionnaires; packaging of census questionnaires; software development for data collection; dispatch and delivery of census material; census mapping; publicity and public relations; training; return collection of census questionnaires and other material; inventory and storage of completed questionnaires; scanning and data entry; data processing and tabulation; and publication and dissemination.

2.340   The following factors should be taken into account when considering whether to contract out any specific activity.

    (a) Core census activities, such as the questions to be asked in the census questionnaire or the enumeration operation, should not be contracted out.

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[37] The principle of fairness indicates that procurement should be free from favouritism, self-interest or preference in judgement. Transparency is a principle that ensures that timely information about existing conditions, decisions and actions relating to procurement activities, as well as about procurement policies, procedures, opportunities and processes, is clearly defined and made known simultaneously to all interested parties. For more information, see *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 2.128–2.132.

[38] The focus here would be not to rely solely on the documentation submitted in response to the tender requirements, but also to extend the assessment to the actual physical and producing capacity of service providers.

(b) The confidentiality and security of census data collected should not be compromised through any contracted activity of the census operations in order to retain the trust of the public.

(c) Competitive bidding should be invited for contracted activities and demonstrations of capacity and good project management skills should be verified before outsourcing.

(d) Each contract should specify the terms of reference clearly along with timelines, delivery schedules, change control and dispute resolution clauses.

(e) The risk of contracting out should be evaluated.

(f) Quality assurance guidelines for each product or service should be laid out when contracting out.

(g) Timeliness of the delivery schedules should be closely monitored by census project managers to avoid delays along the critical path.

(h) Contracts should be put in place in a timely manner. Sometimes, it may be prudent to have two or more vendors provisioning the same product or service if national legislation allows, so that there is a backup at all times.

(i) Payment to the contractor should be scheduled such that the incentive to deliver quality work in a timely manner is maintained.

(j) Contracting out particular phases and activities of the census should be carefully weighted against building in-house capacity for provision of those services.

2.341   Contracting out activities does not relieve census managers of their responsibilities. If contractors fail to deliver, the census may fail. So managers have to work closely with contractors and monitor them regularly to ensure success.

2.342   Whether external consultants or outsourcing is used depends on the requirements of the organization (including requirements for confidentiality and security), whether the required skills are available in house and whether projects can be outsourced cost-effectively. Outsourcing decisions should be made within the context of a larger organizational plan that identifies choices between hiring and training staff or using external service providers to augment or replace resources for specific projects. There is no clear-cut distinction between hiring consultants, the use of external service providers or outsourcing; quite often a system will contain elements of all of these working together with in-house resources.

2.343   The agency may have limited skills of the type needed for the implementation of a particular specialized system, or IT may not be a core part of the business. If this is the case, a solution in which a greater proportion of the work is undertaken by resources outside the census agency could be considered. Instead of simply acquiring hardware and software with which to assemble a processing system, a total solution would be requested, with the successful tenderer taking responsibility for all IT aspects of the processing system.

2.344   In many countries, bilateral agreements allow for the use of international consultants as technical advisers. In these cases, census managers should take advantage of the opportunity to assist in capacity-building within the census agency.

2.345   In some countries, tender committees have been formed which consist of the ministry of finance and a general control association, as well as the statistical office. The committee is usually responsible for calling for tenders, requirements and conditions, evaluation of tenders and selecting the most suitable ones.

1.   Differing objectives

2.346   It is inevitable that any external resource provider will have additional or different objectives from those of the census agency. For example:

    (a) A specialist mapping service provider may be more interested in producing maps to the highest standards of cartography than in offering a service that allows enumerators to locate dwellings effectively.

    (b) A private sector business will be obligated to provide a return to shareholders rather than satisfying the public policy needs that drive government agencies.

2.347   As a result of these differing objectives, in all cases where external resources are employed, careful control is needed to ensure that the selected external provider delivers a cost-effective solution that meets the census agency's needs. The use of external service providers should be carefully specified, planned and monitored.

2.   Preparing specifications

2.348   Successful outsourcing initially requires the census agency to have a clear understanding of the requirements, as these have to be unambiguously specified to the service providers. If the agency cannot express its expectations and priorities clearly to service providers, the service providers cannot be expected to achieve them. It is also necessary to ensure that any legal documents (such as conditions of tender) are fully understood by all parties.

2.349   The way in which the specification is passed on to the external providers will, to some extent, be determined by the laws, rules and procedures that apply in a country. However, a detailed written specification should be set out to serve as a benchmark against which performance can be measured later in the process.

2.350   During the preparation of a specification for outsourcing or an external service provision, about half of the time should be used in establishing the objectives of the project, the outcome to be achieved and the procedures to be followed in attaining that outcome. The standards to be met must also be specified (for example, for a data entry operation, an allowable proportion of erroneous keystrokes could be specified).

2.351   The next largest amount of time should be spent on documenting precise price and payment terms (where goods and services are to be purchased).

2.352   The specification must be designed to allow for requirements changing over the life of the project. This should include a clear method through which changes are agreed and approved by both the census agency and the service provider.

2.353   Within this overall framework, the specification should:

  (a) Clearly state the scope of the project;

  (b) Identify the deliverables and the associated schedule of dates for completion of each deliverable (milestones);

  (c) Identify key personnel by name and qualifications, and set out rules for their replacement, where necessary;

  (d) Clearly define invoicing and payment specifications, as well as time frames and methods for payment of penalties;

  (e) Set out training programmes and documentation requirements;

  (f) Contain change control and dispute resolution clauses.

3.   Monitoring the outsourced project

2.354   It is important that outsourced projects be carefully monitored against the specification. This monitoring must include early identification of problems (milestones are important in this process).

2.355   Particular care should be taken where the outsourced work is being developed or undertaken at a site remote from the location of the census office.

2.356   Regularly scheduled meetings (or other communications such as telephone conferences or videoconferences) between census agency and service provider staff are essential for managing external relationships and ensuring that expected contract results are achieved. Compliance with scheduled completion should be specified as a contract requirement, with listings of key attendees from all parties specified in the contract. The frequency of the meetings should be specified along with responsibility for recording and publishing decisions made or items agreed to.

2.357   It is considered essential that a system of cascading meetings be established, with project team staff meeting their counterparts frequently for routine monitoring. This is a key area that might be neglected if not considered early enough in the proceedings. Even if the requirements are clearly specified, it is still possible for problems to arise in the delivery process, with the potential for the outcomes to be achieved late or not at all.

2.358   Clear and open communication is a critical success factor in this element of managing a census. Care should be taken to ensure that all negotiations with external providers are done with a degree of common sense and appreciation of all viewpoints and constraints, as well as rigorous contract preparation.

2.359   While many forms of the specifications will include penalties for failure to meet deadlines or quality standards, these are rarely effective in a census context. What is required is a census held successfully on a date specified months or, in many cases, years in advance, not cash from penalty payments. Attention to detail in the specification documents is a major step towards achieving this. It is also important to develop and manage a good working relationship between the service providers and the census agency.

L.   Use of technology

2.360   Access to modern technology has led to large increases in efficiency and monitoring of, and control over, various census operations. However, while on the one hand technology provides considerable benefit, on the other hand it increases dependence on technology providers and introduces new challenges and risks. The key to the successful use of technology in a census is to clearly understand the rationale behind introducing the technology solution and considering a range of key success factors for technology adoption, which may include suitability, security, scalability, stability, safety and skills.[39]

1.   Planning for technology solutions

2.361   Careful planning and management is central to the successful use of technology. Technology adoption has a range of advantages, such as higher levels of data accuracy, more timely data release, efficient operational controls, better capacity for monitoring and supervision, efficient payroll systems, and easier data access for users. While superior technology may be available, each country must evaluate whether it is suitable for the context in which it operates. Planners have to weigh the trade-offs between such advantages and whether the solutions are affordable and can be successfully implemented. In addition, as the new technology adopted may relate to only one part of the census operations, planners have to take into account how it will affect other operations. For instance, if the planners decide to use GPS point data for address canvassing, this may have an impact on the design and content of the questionnaire, as well as the way the enumerator will conduct the interviews. In addition, adequate time should be devoted to testing new systems in an integrated fashion so that there are no surprises when the operations using the new technology are implemented. Maintaining data security and confidentiality should also be of paramount concern.

2.362   Census project managers should plan for and manage the following risks in adopting new technology:

(a) Incompatibility or other integration issues between different types of hardware or software;

(b) Solution outage or failure (could be for many reasons – lack of connectivity, hardware failure, battery life, GPS blind spots, software bugs, device theft);

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[39] See *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part two, chap. XIII.

(c) Lack of skills or knowledge by system users, in particular temporary census staff;

(d) Insufficient or inadequate communication between technology staff and business staff, leading to misunderstanding of requirements;

(e) Hacking, online attack or other IT security event;

(f) Maintaining, upgrading or decommissioning old or legacy systems;

(g) Lack of documentation or reliance on a small number of key people;

(h) Huge amount of digital data available, creating a potential distraction for staff;

(i) Challenges related to microdata management, which may be novel to the office.

2.363   The successful adoption of new technology requires that managers have strong project management skills. Anticipating potential challenges and thinking ahead about alternative ways to ameliorate problems are essential to sound planning. Since many countries may not adopt seamless end-to-end solutions, but solutions to particular operations, integration needs to be carefully planned and tested before being adopted. For instance, countries using electronic devices to do address canvassing, enumeration, operational controls and payroll accounting for field staff may design integrated systems that have fewer challenges once deployed, compared with countries that use address canvassing on electronic devices but enumerate and account for field staff time on paper.

2.364   Another challenge is accurate budgeting for new processes. Since countries often use estimates from past censuses as a starting point of planning, when new technology is used, there may be a trade-off between the cost of the technology and the efficiency achieved in operations. Thus, managers have to be skilled business analysts to estimate the census budget.

2.365   In view of how fast technology changes, one of the challenges managers encounter while planning for technology solutions is determining what technology to adopt, what platform to develop the electronic questionnaire on, and what brand of handheld electronic device to buy. This is especially true for countries that plan with long-time horizons. It is difficult to predict the direction technology will take three years in advance, and whether the one selected will be the most reasonably priced and well supported.

2.366   Digital census data collection (electronic questionnaire administered via handheld electronic devices or the Internet) is being employed by an increasing number of countries. This technology in general has the potential to improve the quality, relevance and timeliness of the census. However, its introduction will create various challenges in the implementation of census operations. The decision to use an electronic questionnaire instead of "paper and pencil" interview methods should be done in consultation with all stakeholders and with a clear understanding of the technology. Census agencies should undertake an evaluation well in advance of the census to determine whether this technology is appropriate for their own situation. To the extent possible, the determination of whether digital collection meets the needs of a census operation should be based on information generated by hands-on

experience and field tests. The decision requires taking into consideration a number of critical factors, including the following.

(a) **Cost-benefit analysis.** The adoption of any new technology presents challenges. As a result, new technology should be adopted only after costs and benefits have been carefully considered. Cost components of digital collection include system design, software development, hardware acquisition, communication, system maintenance, technical support, human resource planning and training. While these costs represent a substantial initial investment, these devices and systems could be reused for future surveys, which would be less expensive and of higher data quality, and the data could be available for analysis much faster than when using paper-based methods. Another significant long-term benefit is the elimination of the need for printing paper questionnaires, distribution and return of census materials, storage and data processing. Other benefits of digital collection include the ability to monitor data collection in almost real time, providing better workflow management and supervision of enumerators, especially in cases where corrective actions during data collection are needed; and the elimination of the time required for data processing from paper forms and the errors that result from that operation. Though it may not be possible to definitely state that digital census data collection is cheaper or more expensive than paper-based censuses, it does seem that, in general, the extra set-up costs required for digital collection are more likely to be offset when the survey population is large and the questionnaire design is complex. The benefits of migrating to digital collection should also be looked at from a societal standpoint. It may be more cost-effective to invest initially more resources in a digital approach, provided that the digital output products are expected to realize much larger long-term benefits (higher accuracy and lower cost) inside and outside the statistical agency, creating a truly national initiative.

(b) **Planning.** The success of digital data collection depends on sound strategic, operational and managerial planning, as well as a well-designed institutional environment. Plans should be drawn up on the basis of a realistic assessment of effort and costs, including accurate estimates for maintenance and associated costs, and with sufficient time allowed for preparation and testing. New technology should be thoroughly tested before deployment. Such testing must be built into the project schedule and allow adequate time to make improvements prior to implementation.

(c) **Contingency planning.** In the event that the use of an electronic questionnaire fails in some areas, an alternative plan must be available (including the possible use of paper questionnaires) to ensure successful completion of the census operation. Formulating backup options for expected challenges or system failures is essential to sound contingency planning.

(d) **Technical skills and capacity development.** Given the highly technical nature of digital collection, careful consideration should be given to the type of expertise

needed to build, integrate and implement a digital collection system. This requires evaluating the technical skills held by, and the distribution of responsibilities among, the staff of the statistical agency, and developing training and capacity-building programmes or hiring contractors, where appropriate.

(e) **Leveraging experience in use of new technology.** Existing in-house experience in digitization of enumeration areas and surveys must be taken into account when determining what will and will not work in the country. It is important to build capacity and skills with digital data collection in smaller surveys before deploying them in such large-scale operations as censuses.

(f) **Appropriate hardware and software.** Hardware and software needs should be considered carefully taking into account the minimum hardware requirements for installing and operating the electronic questionnaire, in addition to any restrictions on the operating system on which it works (see the next subsection for information on software and hardware evaluation and acquisition).

(g) **Monitoring.** A rigorous monitoring system is crucial for achieving complete and accurate census results. Given the complexity and the hierarchical structure of census operations and the associated delineation of responsibilities, digital collection programmes must provide comparable sets of tools for enumerators, supervisors and managers to employ in the management of their work.

(h) **Data transfer from the field.** A major part of the consideration to employ digital data collection includes the data network infrastructure to use, whether it be cellular networks, the Internet, other types of connectivity between devices or a combination of those. If the census operation plan calls for transmitting data and monitoring fieldwork directly from the data entry handheld devices, then widely available cellular or Internet coverage is essential. Where the infrastructure for cellular networks coverage is poor or non-existent, mechanisms need to be developed for the transfer of data from the field by establishing multiple data collection stations with means of connectivity to central servers at headquarters.

(i) **Data security.** Digital data collection requires investments in data security and staff training to prevent unauthorized access and the loss of sensitive individual data. Security concerns include failures in hardware and software, human errors and accidents. Data transfer protocols from the field should be designed with security features, including daily backup and encryption.

2. Software and hardware evaluation and acquisition

2.367 Fundamental to the adoption of any technology is understanding the purpose to which it will be put and how that purpose fits into the overall census plan. Fully understanding the system requirements will make the acquisition decision and the trade-off between functionality and cost easier to establish.

2.368   For example, when developing the data-processing system, decisions on factors such as the data capture method to be used, what editing and processing will be applied to the data and how the data will be stored and disseminated need to be made. These decisions must be made early enough that sufficient time is available for the evaluation and acquisition of software and hardware.

2.369   The budget available to the project is also a vital factor in making decisions about hardware and software. Costs of employing data entry staff and the level of the computing infrastructure are also important considerations. For a low-budget project, it may not be feasible to acquire and deploy sophisticated state-of-the-art equipment, but the use of less ambitious IT may offer overall savings, as well as greatly increasing the utility of the output from the census.

2.370   Before agencies commence the formal processes of evaluating and acquiring software and hardware, they should take the opportunity to research and investigate other organizations' experiences with similar systems. During this period, it may also be possible to acquire versions of software or hardware that can be used for testing purposes. This will allow agencies to become familiar with, and better understand, the potential benefits or limitations of particular systems. This experience can be valuable when developing evaluation criteria, as outlined in the sections below.

2.1   *Evaluating software*

2.371   Before acquiring and installing software there are many issues that need to be considered, including evaluation of the software against set criteria. Which criteria are critical will depend on what the software is being used for and how complex the function and the software are.

2.372   Important criteria should include the following:

(a) An application can be developed that meets the required specifications.

(b) The software is easy to learn and use.

(c) It is an integrated tool that provides a common approach.

(d) There is an easy development environment for user interfaces.

(e) There is an easy-to-use program development environment (workbench), including configuration management, testing and debugging facilities incorporating breakpoints and step-through capabilities.

(f) The software has the ability to display required objects such as form images, if applicable.

(g) The software has strategic value to the organization responsible for the census, or other elements of the national IT infrastructure, including possible reuse for other surveys.

(h) The software is compatible with current industry trends.

(i) There is current expertise in the product in the organization or externally:

- o Are internal or external staff experienced with the product readily available?
- o What level of training and support is required?
- o What support is provided by the supplier, including training and capacity-building?

(j) There is evidence of the current strength and longer-term viability of the supplier.

(k) The software can be sourced locally or internationally.

(l) It is a well-recognized business with well-known products:

- o Is the product compatible with current industry trends?
- o Is the supplier financially secure?

2.373　In the context of evaluating computer-assisted personal interview (CAPI) software packages, the strengths and weaknesses of each software package should be taken into account. CAPI software packages should be evaluated to assess whether they are robust enough in performance and broad enough in functionality to support a census survey. The evaluation criteria for performance assessment of each CAPI software package should include the following desirable characteristics and functionalities:

(a) **User-friendly development environment for creating, modifying and updating the survey instrument.** The CAPI development environment should be simple enough for use by survey designers and programmers, while providing powerful programming and design tools for creating questionnaires. It should also provide the facility to control the way the CAPI instrument works, including the method of navigation and appearance of the questionnaires; to modify the questionnaire after pretesting and during survey implementation; and to support the design of questionnaires in multiple languages, if required.

(b) **Simple but powerful interface.** The software platform should recreate the simplicity of the paper experience via an easy-to-use interface for recording and correcting answers, as well as a versatile method of navigating the questionnaire.

(c) **Data capture and quality control.** The software must support a variety of question formats found in complex surveys, capture data at different levels of the hierarchy, and collect and store large numbers of survey observations. The CAPI package must also provide quality controls during and after the interview through two types of data consistency checks – those within modules and those across modules.

(d) **Questionnaire navigation.** CAPI survey software should include basic questionnaire navigation abilities such as the possibility to move backwards in an interview for correcting errors and inconsistencies, to pause an interview and resume it at the last answered question, to complete a questionnaire in a non-linear way by moving from one non-sequential module to another, and to constrain interviewers, for example by

preventing them from entering certain blocks of a questionnaire without having first completed other blocks.

(e) **Skipping and branching.** The CAPI program should allow basic and complex skips over irrelevant questions or branching to follow up on a question (basic skips are those that use only the current question's answer to determine whether the next question is relevant; complex skips are those that use either answers from several questions in different modules or answers in different hierarchical levels of the questionnaire to determine whether the next question is relevant.)

(f) **Case management.** The CAPI software should have the capability to gather and update information on the status of cases for monitoring purposes, and to support the work of survey personnel at different levels of the hierarchy (interviewer, supervisor, manager) by providing comparable sets of tools for enumerators, supervisors and survey managers to employ in the management of their work.

(g) **Data management, transfer and export facilities.** The software should have the ability to systematically store large volumes of data, ideally with value and variable labels; the capability to transfer data easily from the field to headquarters; and the facility to export data to the desired format (for example, in the data file format of one of the major statistical analysis software packages, such as SAS, Stata, SPSS or CSV) and to control which data are exported and the method of export.

(h) **Support and documentation.** The software should offer support and documentation for users on how to use and exploit its functionality. The support should be clear, useful and comprehensive.

(i) **Operating requirements.** The operating requirements include the extent to which the CAPI programs are aligned with the types of devices (hardware and operating systems) typically used for surveys.

2.374 The test process for evaluating software should include at least the following steps:

(a) Obtain test copies;

(b) Develop test prototypes and test data packs to prove or disprove the software's ability to satisfy key functionality requirements;

(c) Detail implications for the organization's computing environment;

(d) Get access to reference sites and demonstrations relating to the supplier and its products and gauge user satisfaction, augmented with access to bulletin boards and discussion sites, if Internet access is available;

(e) If it is a strategic product, ensure that there is a viable support mechanism and that the information quality and responsiveness are acceptable;

(f) Conduct tests according to previously established criteria;

(g) Assess and document upgrade policy;

(h) Determine full costing;

(i) Produce a report on the evaluation process.

2.2   *Acquiring software*

2.375   Software for census use in association with selected hardware can be acquired in a number of ways, such as:

(a) Purchasing complete off-the-shelf packages that require no further development;

(b) Purchasing packages that can be further developed for census-specific activities;

(c) Contracting out the provision of specific functionality for parts of systems;

(d) Contracting for externally developed software for complete systems;

(e) Obtaining free software such as CSPro, Survey Solutions, Redatam or CensusInfo;

(f) Joining resources with neighbouring or other countries in acquiring, training for and use of software.

(a)   Package software

2.376   The use of package software, as opposed to developing task-specific software, has become an established practice in many areas of the information systems industry. The major reasons for this are the reduced risk, cost and time frame associated with the implementation of proved solutions to recognized business needs and the reduced overhead involved in maintaining the resulting system by procuring packages from vendors committed to their continued maintenance.

2.377   Although the rationale for using package software is clear, many agencies have been disappointed with the results of package implementation. The most frequently encountered problems are:

(a) A mismatch between package functionality and agency requirements;

(b) The level of customization required to ensure successful implementation;

(c) Inflexibility of the package to meet the changing needs of the agency;

(d) The level of maintenance required;

(e) An inadequate level of vendor support;

(f) Poor vendor choice;

(g) The amount of effort required to interface a package to existing systems.

The above problems are almost always attributable to an inadequate analysis of business needs or a poor procedure for the evaluation and selection of a package, or both.

2.378   Off-the-shelf packages would usually be acquired through direct negotiation with suppliers after an evaluation study has been conducted to determine that these products will

fulfil the stated requirements. There is a need to consider whether a site licence is required or whether individual licences would be more appropriate. With software acquisition there is usually room for negotiation, and discounts may be available for higher-volume purchases. A licence arrangement to allow many concurrent users should be considered, as this is usually a cheaper alternative, since fewer licences need to be purchased than the total number of possible users. There are other variants worth pursuing, such as differential pricing, that is, limited developers' licences and unlimited licences for run-time access.

(b)   Contracting out specific functionality for parts of systems

2.379   Externally developed application-specific software must be tightly specified, developed and controlled, and therefore should be subject to contracted conditions that are closely monitored. This is usually based on a formal request for tender or statement of requirements and may be linked to the acquisition of hardware. It is also essential to have good contract management practices in place, otherwise many of the benefits established in the planning processes will be lost in the execution.

(c)   Contracting out complete software systems

2.380   A simpler but perhaps more expensive method is to contract out specific functionality for specialized software. Broad requirements might be specified as "the requirement to deliver captured data from every form", which leaves contractors to acquire and develop software themselves. While this is a simpler method for the organization, it will probably be more expensive, and communication with the contractor has to be very good to ensure adequate detailed specifications.

(d)   Developing software applications in-house

2.381   If there is no suitable software available off the shelf, it might be feasible to develop the required software in house. The decision to take this action will depend on a number of factors, for example:

  (a) The budget available;

  (b) The technical skills available in the organization and the ability to retain those skills (a growing problem in the IT industry);

  (c) The timetable for development;

  (d) The complexity of the required software.

2.382   Whether software is developed in house or contracted out, the same strict control over development issues (for example, standards, tools used, training of staff and adherence to timetables) must be exercised. In certain circumstances, such as developing applications in GIS for the purpose of census mapping, it would be necessary to assess the in-house investment against contracting out. In essence, these decisions have to take into consideration whether the software and the accompanying capacity to develop applications is intended for a one-time use (for the census only) or will have a repeated and multiple use within the

national statistical system – which, in turn, necessitates a strategic and holistic overview of the software needs and use.

2.3   Evaluating hardware needs

2.383   The requirements for evaluating hardware for census operation will depend on the nature of the hardware, its complexity and any links with existing hardware or software, and whether it will be reused in other statistical data collection programs. Strict evaluation criteria need to be drawn up before the hardware is acquired for evaluation. Many of these criteria will be the same as the ones set out in subsection 2.1 above on evaluating software. Before the evaluation takes place, specifications must have been drawn up to describe clearly the requirements for the hardware, and suitable hardware acquired on the basis of a tender or direct purchase, if there is only one possible supplier.

2.384   An evaluation team should be set up to carry out the evaluation. The number of people involved in this team will depend on the complexity of the hardware, the number of different hardware configurations to be evaluated and the resources available. The members of the evaluation team must have the necessary knowledge and technical skills to make a valid, consistent and unbiased assessment of the equipment, and the ability to manage an objective evaluation process over time. Technology often changes at a fast rate and there is the possibility that updated or new hardware becomes available after the evaluation has been completed. It is important to remember that, despite what performance promises may be made by vendors, any decision to implement this new hardware must be based on full evaluation. It should not be taken for granted that updated hardware will necessarily perform better or be more suited to the particular census application.

2.385   The evaluation should encompass a number of phases to ensure that the hardware is thoroughly assessed. It is important to test the operation of the equipment in the environment in which it is to be used to ensure that it will perform properly in the production environment.

2.386   Initial capital cost is only part of the total cost of the hardware to the agency. It is one factor, but not the only, or necessarily most important, factor in evaluating hardware. There is a relationship between savings and risk, which means that cheaper equipment has the potential to cost more in the long term if user requirements are not met or the equipment needs replacement before it has done the required job.

2.387   Product quality is another issue. Some hardware systems can be put together using a number of different off-the-shelf components, but this requires extensive testing, including systems integration testing involving all components, and assurances that the supply of like products can be guaranteed over time.

2.388   The establishment of a set of standards for deliverables and a rigorous change management process is essential regardless of whether one has a single supplier with a proprietary "box" or whether the build of the box is done in a modular fashion.

2.389   An important point to note when evaluating hardware is the period of warranty offered by the vendor. It is desirable that the warranty covers the time needed to carry out the census.

2.390   In the context of evaluation of handheld electronic devices for use with CAPI software, factors to consider include:

(a) Portability, including weight, size, and ease of use and transport;

(b) Battery life, which should be sufficient to perform several hours of fieldwork without recharging;

(c) Screen size, resolution and visibility, preferably using a monochrome screen not easily affected by bright sunlight;

(d) Processors and random-access memory (RAM), taking into account that for better performance and rapid navigation, a faster processor and a sufficient amount of storage are needed;

(e) Stability of the operating system;

(f) Data storage and backup possibilities, including external data cards and flash drives (SD/MMC cards) for adequate storage and for backing up data;

(g) Connectivity options, such as cellular communication, Wi-Fi, Bluetooth, USB, near-field communication and other types of connectivity between devices;

(h) Ruggedness and durability in field conditions, which may include hot and cold temperatures, rain, sandstorms, dust or heavy wind;

(i) Inbuilt functions such as GPS receiver, camera, voice recorder;

(j) Location accuracy (with respect to geographical location) for fieldwork application, especially if GPS functionality is required.

2.4   Acquiring hardware

2.391   Hardware is usually acquired on a similar basis to that for acquiring software. Where the hardware is new technology for the organization, there will normally be a tender process to ensure that the hardware is the best solution, technologically and financially, for the organization. The request for tender must be compiled carefully, with due regard to the legal requirements of the organization and government policies, including ethical and probity considerations. If there is an existing system of panels of suppliers for specific types of hardware, and these are relevant to the requirements of the organization, then they should be used to purchase or lease the hardware required. Ethical and probity issues are of paramount importance in any acquisition process and if not handled properly can be the cause of delays or other problems, such as public mistrust.

2.392   A detailed specification of requirements must be done before the tender document is released or panel suppliers are contacted. This specification will be required to form the basis of the evaluation criteria.

2.393   It is important to evaluate the real requirements of the organization and to acquire hardware that is appropriate for the job. There may be pressure to buy older technology to save money, but this can be counterproductive if there is a need to upgrade other components. On the other hand, it is important not to pay too much for hardware by buying equipment that delivers more performance and functionality than is needed. Careful planning is required to gain the most benefit from hardware purchases.

2.394   There are some basic rules that should be followed for acquisition of hardware:

(a) Use requests for proposals or requests for tender to control the process;

(b) Try to keep proposals simple;

(c) Purchase only what is required, but as much as possible encourage competitiveness in the evaluation process;

(d) Shortlist, focusing on the best technical solution and overall value for money;

(e) Negotiate the warranty period;

(f) Negotiate free training to be provided by the vendor;

(g) Consider the level of local maintenance support available;

(h) Consider the advantages and disadvantages of purchasing locally compared with internationally;

(i) Avoid being under any obligation to a vendor;

(j) Consider ethics and probity issues at all stages.

2.395   Box 15 presents an example of technical specifications for GPS-enabled handheld devices for geospatial data collection and related accessories.

Box 15. Technical specifications for GPS-enabled handheld devices for geospatial data collection (data loggers) and related accessories

Item no.	Description and minimum/mandatory specification		
1	**Reference/equivalent specs**	**Trimble Juno 5D**	**Trimble Juno 3B**
	DGNSS accuracy postprocessed	2–4 m	1–3 m
	DGNSS accuracy real-time*	2–4 m (RTCM), 1–2 m (enhanced GPS handhelds with SBAS/WAAS/EGNOS)	2–5 m
	Integrated SBAS	Yes	Yes
	NMEA output	Yes	Yes
	RTCM input	Yes (DGPS, RTCM 2.3)	No
	Operating system	Windows Embedded Handheld Professional 6.5. Android 4.1 (selected configurations)	Windows Embedded Handheld Professional 6.5
	Processor	1.0 GHz (5D and 5D Barcode, Enhanced GPS, or RFID handhelds) OMAP DM3730	800 MHz Samsung processor
	Memory (RAM)	512 MB	256 MB
	Screen details	10.9 cm / 4.3", WVGA TFT, 480x800 pixels	8.9 cm / 3.5", colour touch screen, 240x320 pixels
	Data storage	16 GB, 32 GB (Barcode, Enhanced GPS, or RFID handhelds)	2 GB
	Expansion slots	1 (microSDHC)	1 (microSDHC)
	Alphanumeric data entry	Soft input panel (SIP) on screen keyboard	Soft input panel (SIP) on screen keyboard
	Integrated barcode scanner	Yes (Barcode handheld)	No
	Integrated RFID	Yes (RFID handheld)	No
	Integrated Bluetooth	Yes	Yes
	Integrated Wi-Fi	Yes	Yes
	Integrated camera	8 MP with flash	5 MP
	Cellular modem	Yes	No
	Cellular voice capability	Yes	No
	Weight	0.4 kg (0.9 lbs) / Barcode handheld 0.50 kg (1.10 lbs) / Enhanced GPS handheld 0.45 kg (0.99 lbs) / Enhanced GPS and Barcode handheld 0.50 kg (1.10 lbs) / Enhanced GPS and RFID handheld 0.55 kg (1.21 lbs)	0.30 kg / 0.67 lbs
	Battery life	8 hours	10 hours: Internal GPS, and backlight
	Ruggedness	Withstands 1.2 m / 4 ft drop	Withstands 1.2 m / 4 ft drop
	Environmental	Dust-proof and resistant to heavy wind-driven rain per IP65 standard	Wind-driven rain and dust-resistant per IP54 standard
	Operating temperature	–30º C to 60º C / –22º F to 140º F	–20º C to 60º C / –4º F to 140º F
2	Accessories: extra battery		
3	Accessories: memory card	1 (microSDHC) 16GB	1 (microSDHC) 16GB

Source: UNFPA INVITATION TO BID. ITB NO.: UNFPA/ETH/ITB/15/028, 13 July 2015.

M.   Documentation system

2.396   The cumulative experience of past censuses is invaluable in the preparations for the next population and housing census. The retention of institutional knowledge and institutional memory gained during census operations is fundamental because of the long interval between two censuses (usually 10 years). It is also more likely that the more experienced staff will move into other fields of statistics and senior staff will retire in the period between two consecutive censuses. Therefore, a census agency is usually exposed to the loss of qualified staff, and their knowledge and experience might not be available and at hand at the time of the next census.

2.397   Documentation of census operations is crucial and plays a key role in various ways:

    (a) Evaluation of the quality of each phase of the census as it is implemented;

    (b) Evaluation of overall census quality and preparing recommendations for the next census;

    (c) Preservation of census practices for subsequent censuses and transmission of experience and knowledge.

2.398   Documenting census experience is certainly as old as census taking itself; yet it may still manifest as one of the weaknesses in census taking, and requires close attention in the planning phase of the census. In this era of advanced technology, documentation of the census experience can be done more effectively through developing a system for systematically recording all experience. This is a relatively complex task as it requires developing a framework and protocols regarding what to document and when to document it within the many census processes in order to ensure a harmonized and standardized documentation process.

2.399   The census operations documentation system should be developed using resources available in-house; in doing so, the following issues should be taken into consideration for assessing the capacity (staff, time, technology and other resources) needed for comprehensive documentation.

    (a) **Identifying the objectives of documentation.** This may include documentation of overall census operation covering the activities undertaken during the planning, development and implementation stages of census phases and their outcomes.

    (b) **Determining the principles for what to document.** The list of all possible materials, data files and outputs should be considered.

    (c) **Determining the principles for when to document.** The timing of documentation, in particular for census processes – such as development of the questionnaire, field enumeration, data processing and dissemination – can be determined on the basis of the defined outputs of each task covered in each process.

(d) **Decision on method of documentation.** For an efficient system, it is desirable to establish a system for digital documentation to be able to easily access the documents.

2.400   In addition to documenting census operations, all census statistics need to be accompanied by a series of information and metadata – a particular documentation regarding the methodological and other relevant facts that will enrich the meaning of census results. Examples and elaboration of these issues are provided in chapter VIII, section B, of the present handbook. At this point, and in the context of census planning, the following points related to metadata and related documentation need to be outlined.

(a) What metadata need to be provided to the users?

(b) What is the most efficient and cost-effective means of gathering all necessary metadata and documentation?

(c) What are the most efficient and effective means of ensuring that all necessary documentation and metadata are preserved along with the digital resource itself?

2.401   Both documentation systems (for operations and metadata) are of primary importance and require meticulous planning at the very early stage of census operations. A dedicated team should be established for planning and development of these systems in collaboration with all stakeholders. Basic principles for what, when and how to document should be determined with all stakeholders that are involved in one way or another in any stage of census operation. Documentation guidelines, as well as training in the principles and implementation of these systems, are necessary for the staff who will be responsible for documentation activities. As for the development of efficient systems, that requires series of tests for checking particular functions and steps. The pilot census should be designed in a way that also allows thorough testing of the overall system of documentation with the involvement of the responsible staff.

2.402   Box 16 presents an example from the Indian census of 2011 on planning a system for the documentation of census experience.

Box 16. Planning a system for documentation of census experience: 2011 census in India

India has the practice of documenting detailed data regarding all census-related activities systematically and recording them in the form of an administrative report. A report is prepared separately for each province, containing the province's experiences in overcoming various hurdles and successfully completing the census activities. The table of contents for the administrative report of the 2011 census was as follows:

Volume I: **House-listing and housing census**

Chapter I: Introduction and building up of the organization

Chapter II: Preparatory steps and preparations for the census

Chapter III: Touring and training programmes

Chapter IV: Census schedules and instructions: translation, printing

Chapter V: Preparation of rural and urban frame and procurement of maps

Chapter VI: General information on human resources, budgeting, publicity, awards

Chapter VII: Receipt and dispatch of census material

Chapter VIII: House-listing and housing census: house numbering, preparation of charge register, experiences from field operations

Volume II: **Population census**

Chapter I: Preparations for population enumeration

Chapter II: Population enumeration: field operation

Chapter III: Generation of provisional results of population enumeration, post-enumeration survey and concluding remarks

Volume III: **Data centres, data processing and validation of data**

Chapter I: Upgradation and maintenance of data centres

Chapter II: Storage and receipt of census material after census operations

Chapter III: Technology used for scanning purposes

Chapter IV: Processing and validation of data

Chapter V: Editing, coding and generation of tables

N.   Quality assurance

1.   Introduction

2.403   In the census context, there are six attributes of quality assurance:

    (a) Relevance;

    (b) Accuracy;

    (c) Timeliness and punctuality;

    (d) Accessibility and clarity;

    (e) Comparability and coherence;

(f) Interpretability.

2.404   The essential quality attribute of relevance to census output, and how to ensure it, was discussed in chapter I. Clearly, meeting targets for timeliness and accuracy will be hollow achievements if there is not a high degree of national relevance in what the census produces. These two attributes (timeliness and accuracy) are essentially trade-offs. Higher accuracy can be obtained for poorer timeliness or vice versa. Quality is relative, and in the end is based on what is acceptable, or fit for the purpose, rather than a concept of absolute perfection.

2.405   Quality is the outcome of processes, and deficiencies in quality (for example, delays in processing) are usually the result of deficiencies in process rather than the actions of individuals working in that process. The key to quality assurance and improvement is to be able to regularly measure the timeliness and accuracy of a given process so that the process can be improved when a fall in quality is indicated. The focus of quality assurance is to prevent errors from recurring, to detect errors easily and to inform the workers so that errors do not continue. This simple feedback loop is represented in figure VIII.

Figure VIII

Quality assurance circle
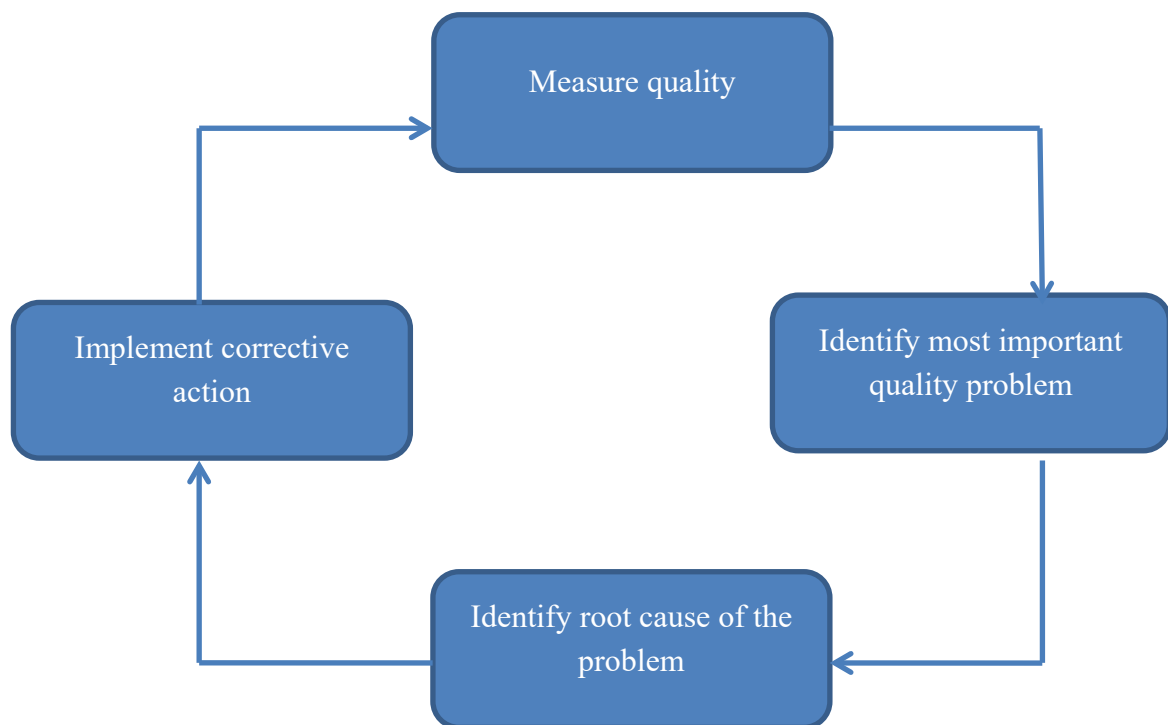
2.406   Being iterative, the quality circle is particularly applicable to tasks that are highly repetitive such as the processing phase of the census. However, the general principle applies to all processes. For example, there is less opportunity to evaluate performance, identify problems and implement corrective actions in phases such as enumeration owing to time constraints, the once-only nature of some of the processes, and communication issues.

However, it still can be established with careful planning and documentation in advance of the census.

2.407   It is important that a complete evaluation take place at the end of each phase of the census. This should be done in particular for phases such as enumeration, so that the organizational learning inherent in the quality circle is carried forward to the next census.

2.408   Since people play a key role in most census processes, they are in a good position to identify problems with quality and provide solutions. Quality is therefore not just the outcome of mechanistic applications of predetermined measures but relies on a combination of:

(a) Established, documented processes;

(b) Systems to monitor the outcomes of these processes;

(c) Active encouragement by management to involve staff undertaking the processes in identifying and resolving deficiencies with quality.

2.409   While elements of the quality circle, such as mechanisms to monitor quality, may have some superficial resemblance to some of the elements of traditional quality control approaches, they are quite different. Traditional quality control is based on correction of error after the event, whereas the emphasis of the quality circle is on improving the process that caused the "error", which may be any of the timeliness or accuracy attributes falling below specified levels.

2.410   A simple error correction process may suffer from any of the following.

(a) It adds significantly to the cost of the operation.

(b) Errors in the inspection process can fail to detect true errors or falsely identify errors.

(c) The correction process can introduce errors into the data.

(d) Operators take less responsibility for the quality of their work, believing it to be the responsibility of the inspectors.

(e) Where a sample of units are inspected, the quality of data is only ensured for those units that are inspected.

2.411   The emphasis should be on process improvement rather than correction. Therefore, an important aspect of quality management may not be to correct errors detected through the quality monitoring process unless they are of a severe nature or are generally applicable. For example, a generally applicable error could be a systems error that miscodes every occurrence of a common event. Resources are thus better focused on improving processes and thus overall quality. An example of how quality assurance can be applied to the census data enumeration can be found in appendix III of the Philippines 2010 census.

2.   The role of managers

2.412   Managers have a vital role in establishing quality. The biggest challenge facing managers is first to establish a culture within the census agency that has a focus on quality issues and to obtain the commitment of staff to strive to achieve high-quality goals. At the same time, managers need to be aware that to achieve high-quality outcomes they need to give their staff responsibility to achieve these outcomes. Managers who do not delegate responsibility will find it difficult, if not impossible, to establish teams that strive for high-quality outcomes.

2.413   Managers must ensure that staff understand the philosophy behind the approach to quality. As mentioned above, staff involvement is a vital ingredient of quality improvement. Therefore, an environment needs to be established where staff contributions are expected.

2.414   The second part of their role is to ensure that clients' expectations are known and that these expectations are built into planning objectives and into the systems that are to deliver them.

2.415   Thirdly, processes need to be documented and understood by the staff implementing them. Systems and processes for implementing the quality circle also need to be documented and put in place. Questions need to be answered on such issues as how quality is going to be measured, who is involved in identifying root causes of problems with quality, and how the process improvements are going to be implemented. These will vary greatly depending on the nature of the process. Appropriate quality assurance techniques for each phase of the census are summarized below and dealt with in greater detail in other sections of the handbook.

2.416   The greatest test of management commitment to genuine quality improvement will occur in how management approaches problem solving. Staff will monitor management responses closely and adjust their own behaviour accordingly. Staff will act in accordance with how they see managers behave rather than what they hear managers saying.

2.417   Managers who always react to problems by seeking out people to blame, or who establish systems that focus disproportionately on the merits or demerits of individuals at the expense of the team, are sending messages that are contrary to the thrust of quality improvement. An environment where the emphasis is on fault finding, rather than on finding solutions to problems, or on excessive competition, will result in staff ceasing to be part of the solution and becoming part of the problem. Managers need to take upon themselves the responsibility for problems, as they are ultimately responsible for the systems that caused the problems. They should not seek to transfer the problems to lower-level staff.

2.418   However, even in the best-managed processes, there are circumstances where individuals can be justifiably blamed for impairing quality. These may be individuals who are incapable of performing their duties, deliberately flout procedures or even deliberately sabotage the process. These individuals need to be dealt with by management and in some circumstances their employment should be terminated. Managers must deal quickly with

these cases and act in a consistent manner. By doing so, managers will demonstrate to all other staff their commitment to quality.

2.419   To be successful, it is necessary to create a culture in which everyone has the opportunity to contribute to quality improvement. Most of the staff engaged in census operational work undertake routine tasks, and it is up to management to help them to see the bigger picture, to motivate them and to encourage them to assume ownership of their work. This can be done by promoting a commitment to quality improvement and by adopting a consistent approach to management.

3.   Quality improvement and the census

2.420   The quality circle can be applied to the entire census cycle with:

    (a) Performance in the previous phase being evaluated at any given level of detail;

    (b) Problems with quality ranked in order of importance;

    (c) Comparing with positive experience of the previous census and lessons learned;

    (d) Root causes identified and corrective action implemented.

2.421   The dependencies in the census cycle are represented in figure IX.

Figure IX

Quality circle dependency chart
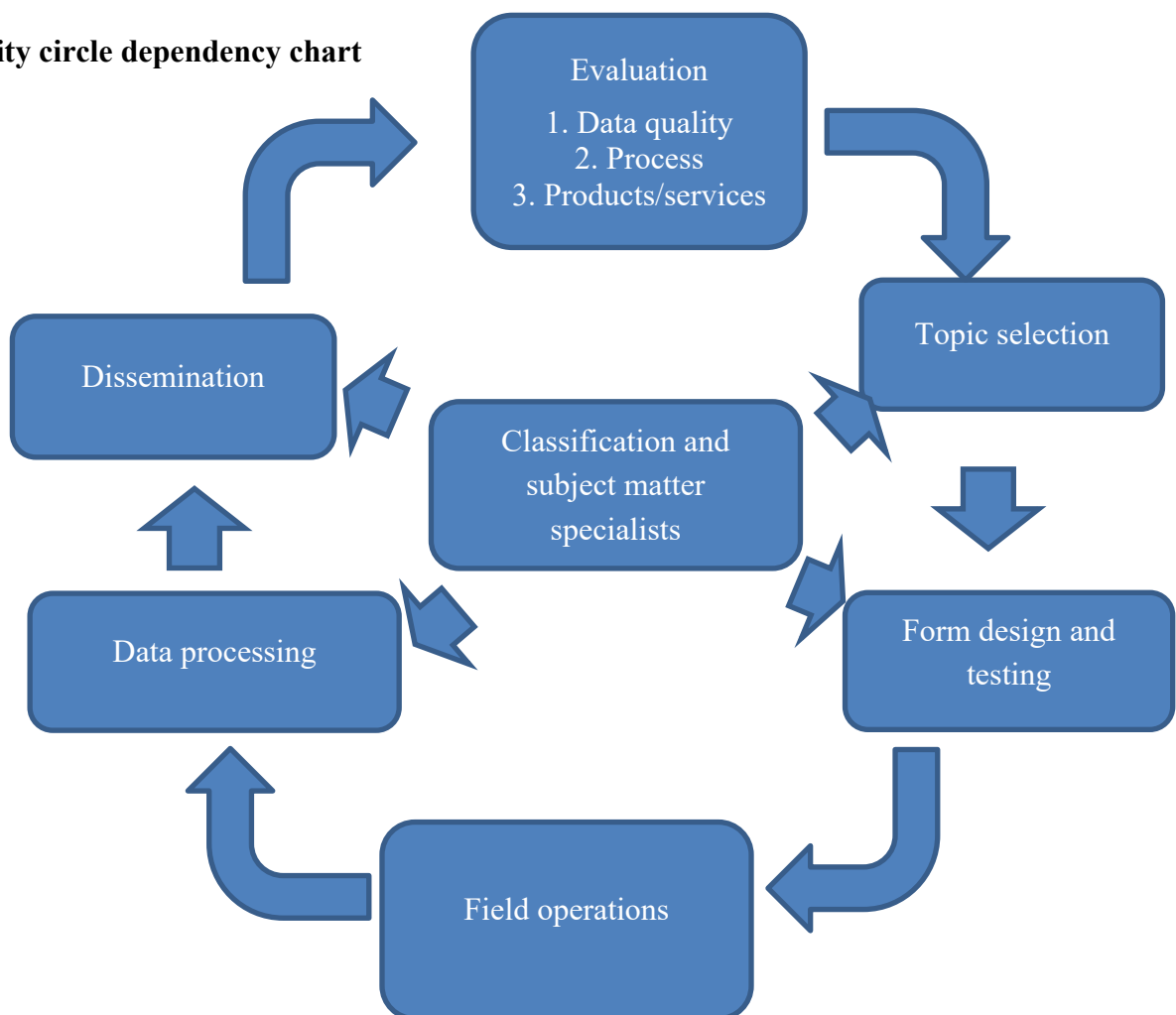
2.422   It is worth noting that it is equally feasible to invert all the arrows in the diagram and read it in reverse order without significantly changing the outcome in terms of quality. Also, it is possible to start at any point in the diagram and achieve the same result.

2.423   The following subsections outline the way in which the concept of a quality circle is superimposed over the census cycle. Much of the discussion on form design, enumeration, processing and dissemination revolves around relevance and accuracy. However, these are subject to time constraints that may be established prior to commencing the census cycle. These are discussed briefly below and in greater detail in the relevant sections of the handbook.

3.1   Topic selection

2.424   The first step in managing the quality of the product (that is, the statistics to be produced) is to ensure that the product will be relevant and meets the requirements outlined in census legislation. The key process is extensive consultation with actual and potential users of census information.[40] A major success factor in this process is full, frank and open communication with users and all areas concerned with the census (in particular, subject matter and classification experts).

2.425   As should be expected, users are reluctant to propose their needs for a future census until they have been able to assess the extent to which their current needs have been satisfied by the output from the previous census. This should be seen as an evaluation process feeding into the current cycle – the first step of quality management.

3.2   Form design and testing

2.426   The next quality management task concerns the testing of each census question and the testing of the design of the form. Again, the quality circle approach is used, with the results of each test being analysed and evaluated before being fed into further design and testing.

2.427   The following areas are the key internal stakeholders of the form design process, whose requirements need to be taken into account:

   (a) The dissemination team, to ensure that the questions asked will deliver the data to meet the needs of users;

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[40] As elaborated above, this process would primarily include government institutions at the national and local levels as major users of census statistics.

(b) The subject matter specialist team;

(c) The team responsible for development of the data capture or processing system. This is especially true for data collection using scanning systems or an electronic questionnaire. For example, positioning of text and delineation of response areas will be dependent on data capture and the processing methodology to be adopted. It is critical that there is continuing coordination between the form design and processing areas, taking into consideration the development of online forms that are used in Internet-based data collection;

(d) The field operations team, which is responsible for training the enumeration workforce and printing the form;

(e) The respondents, to ensure that the forms are easy to complete in mail-out/mail-back self-enumeration.

3.3   Field operations

2.428   The quality management process continues throughout the design of the census field operations. These are tested, as far as possible, in conjunction with form design testing.

2.429   The key internal client of field operations is data processing. However, field operations can also impinge on other areas such as dissemination and classification, and subject matter areas where certain concepts such as what constitutes a dwelling are implemented during the field operations phase.

2.430   Several components of field operations can be subject to specific quality circle mechanisms, as these are likely to take some time and involve iterative processes. These components include:

(a) Demarcation of enumeration areas;

(b) Enumeration area map production;

(c) Form printing, where a sample of forms is rigorously tested for adherence to standards;

(d) Operational control systems (electronic or not);

(e) Data transfer processes if using online and electronic data capture systems.

2.431   Quality monitoring should be established for each of these components and mechanisms put in place to ensure that the outcomes of the monitoring are used to improve processes.

2.432   It is more difficult to implement the quality circle during actual enumeration, owing to the very tight time constraints. However, this can be achieved by:

(a) Clearly establishing the aims of the field operations phase;

(b) Applying thoroughly documented procedures;

(c) Ensuring that the enumerators understand their roles through appropriate training, including inspection of corrupted forms;

(d) Providing opportunities for field staff to be observed operating on the job so that feedback can be given and retraining undertaken.

2.433   However, it has to be acknowledged that during the actual carrying out of the enumeration this approach tends to identify "problem enumerators" rather than systemic or process errors. This means that evaluation following collection is vital. The evaluation should attempt to capture the experiences and suggestions of a range of enumerators and other field staff so that improvements can be made to the subsequent census.

2.434   A general overview of the quality of enumeration can be obtained through:

(a) The use of techniques such as post-enumeration surveys to gauge the level of underenumeration of people and dwellings;

(b) Feedback from field staff;

(c) Measures of the quality of any coding undertaken by field staff;

(d) Measures of non-response rates;

(e) Mechanisms that may be in place to handle queries from the public.

2.435   The effectiveness of the public communication strategy may be assessed by the amount of press coverage (positive and negative) of the census and follow-up surveys to test the reaction to particular advertising.

3.4   Data processing

2.436   The key clients of processing are the dissemination area, the areas of the country's statistical agency responsible for maintaining standard classifications, and those with specialist subject matter knowledge.

2.437   The dissemination area depends on the processing team to obtain data in an agreed format, and compiled to agreed quality standards. This is necessary so that the data can be used in dissemination systems.

2.438   Since the census is part of an overall national statistical system, data from the census are likely to be used in conjunction with data from other collections. Thus the classification and subject matter specialist areas, which are responsible for those other collections, need to be satisfied that the coding, editing and other data transformation processes are conceptually sound and deliver data of acceptable quality.

2.439   Extensive testing of processing systems must be undertaken in advance of the census. Coding processes and training packages need to be prepared and tested using the type of staff likely to be involved in the operations. The processing phase gives the fullest scope for the use of quality improvement techniques, as many of the processes in this phase are repetitive and take a reasonable amount of time. This enables the quality circle to go through much

iteration. It is vital that structures are put in place not only to monitor quality but also to involve processing staff in the identification of problems with quality and in proposing solutions.

2.440   While not universally agreed upon, it is generally not possible for processing to improve the accuracy of census data. At best, processes such as editing may reduce inconsistencies within the data, thus improving its acceptability. Much effort can be expended in correcting apparently inconsistent or inaccurate census data with only an improvement in the fitness for the purpose of the data. It may be a better strategy to educate users to accept slight inconsistencies in census data, rather than developing highly complex procedures that may introduce other errors and impose heavy costs in terms of delay in release of the data, and cost to the community.

2.441   Census data are likely to contain inaccuracies when collected, owing to respondent or data capture error, and there is limited ability to correct these during data processing. Although some simple inconsistencies or missing data can be corrected with confidence, others are usually resolved by making the affected record consistent with observed responses in the wider census database. This process can take significant time and effort to implement, and countries may conclude that a better strategy is to educate users to accept slight inconsistencies within census data.

2.442   Some countries may have a requirement for the final census database to be complete and consistent, to improve its coherence, utility or acceptability, and implement processes to achieve this. Where this is the case, it is important that a summary of this work, including the statistical methodologies used and the changes made to the data, be published to ensure users are fully informed. Where the census database is edited, a copy of the original data should be preserved for archiving purposes.

3.5   *Dissemination*

2.443   Census dissemination can easily be overlooked in the chain of providing a quality outcome for the census as management attention is diverted to the costly and risky enumeration and processing operations. The dissemination area is responsible for the timely delivery of products and services to the census data users. Insufficient planning and resources for this phase can therefore have the effect of delaying the release of the data, thus compromising the overall achievement of the census objectives. The dissemination phase should also be regarded as a continuing process that will service the needs of users over a long period of time.

2.444   Management of quality in census dissemination is driven by concerns to deliver relevant products and services while maintaining the accuracy of the data and ensuring the timeliness and predictability of data release within agreed budgetary limits.

2.445   The first of these objectives is to provide relevant products and services. This can only be done by reviewing the experiences of the previous census products and services and by user consultation processes with both current and potential users of census data.

2.446   The second objective is to ensure that the data supplied from the processing system is accurately transformed into output products. A quality assurance strategy to ensure that data tabulations and transformations are carried out accurately needs to be documented and followed. The quality circle approach to these processes needs to be applied and any gaps identified and corrected through extensive testing prior to the census and maintaining process improvement during the dissemination phase.

2.447   The third quality objective for dissemination is the timely and predictable release of data from the census. While this is the responsibility of all phases of the census programme, special responsibility resides with the dissemination area. The dissemination area needs to be realistic about release dates and ensure that these are communicated to clients early so as to manage client expectations. The involvement of staff actually responsible for the dissemination phase in devising these dates would be the most suitable approach, where this is possible. Dissemination systems and processes need to be available, documented and tested prior to the release of data from the processing phase.

3.6   *Evaluation*

2.448   In the present chapter, evaluation has been considered as the last stage in the census cycle. However, it is also possible to consider the evaluation of one census cycle as being the first step in the following census cycle. Similarly, evaluation of one process within a census cycle could be the first stage in the next process of the same census cycle.

2.449   All aspects of the census programme should be evaluated. The strengths and weaknesses of each task should be identified and action points proposed for future census managers.

2.450   Evaluation of the accuracy of the census data should also be undertaken, to the extent possible, by comparing the census results with similar data from other sources. These sources can include surveys in a similar time frame or previous census results. The purposes of evaluating the accuracy of the data are to inform users of the quality of the current census data and to assist in future improvements. Future improvement may be achieved by improving processes and establishing performance benchmarks against which the quality of the data from subsequent censuses can be measured.

2.451   Evaluation of data accuracy may have two parts. Preliminary evaluation will enable the identification of any problem areas that have not been previously detected through the quality management processes in earlier phases of the census. More extensive evaluation should be undertaken of data items for which problems have been identified or new questions or processes attempted.

2.452   The results of the evaluations should be made available to census data users.

3.7   *Documentation*

2.453   The importance of documentation at each phase cannot be stressed enough. The application of lessons learned in the next census relies on comprehensive documentation.

Given that a census is usually conducted only once in a decade, census organizations need to pay special attention to continuity of knowledge and skills from one census to the next, since the intervening gap is likely to cause loss of institutional memory and attrition of qualified personnel.

2.454 Comprehensive documentation of census activities while they are being carried out, and training of younger personnel to create a pool of knowledgeable and experienced persons by the time the next census comes, are important. Such documentation should be at least available internally, if not published as technical briefs and reports for data users and the public. For more information on documentation and archiving, see chapter VIII.

4.   Performance indicators

2.455 Performance indicators should be established before the census to enable an assessment of the quality of the enumeration. While the performance measures may not be highly accurate or detailed they add value to the understanding of the census results and improve decision-making, in particular when combined with data quality assessments carried out during processing. In particular, performance indicators will be useful within the country in assessing changes between censuses. Many of the measures listed below will also be of benefit to international agencies or individual countries when assessing their situation in relation to other similar countries and understanding the reasons for differences observed.

2.456 Some potential performance indicators include:

(a) Rate of underenumeration, including net underenumeration and gross overcount or undercount;

(b) Response rates to specific questions;

(c) Refusal (and prosecution rates if applicable);

(d) Number of calls to an enquiry service (if established) or comments made to enumerators, classified by type of enquiry or comment;

(e) Number of forms returned through processes other than standard (for example, if mail-back is the standard process, how many forms were collected by follow-up staff);

(f) Performance of the enumerators;

(g) Percentage of imputation;

(h) Coincidence of political campaigns or activities that mention the census;

(i) Adverse conditions experienced during the census (such as unseasonal weather or civil unrest) that might help to explain why an actual score for a performance indicator did not achieve the targeted score.

2.457 It should be noted that some performance measures are beyond the ability of the census agency to control. This does not lessen their usefulness in contributing to an

understanding of the census results; nor does it necessarily reflect poorly on the census agency.

O.   Use of sampling in population and housing censuses

1.   Introduction

2.458   Sampling can be used in different phases of the census. These include:

   (a) In tests conducted before the census (such as pretests and pilot tests);

   (b) During the census itself (that is, using short and long forms);

   (c) In quality control operations, such as for printing and reviewing questionnaires;

   (d) After the enumeration, in the post-enumeration survey.

2.459   Using correct sampling methodologies is critical for all of the activities mentioned above. It is beyond the scope of the present handbook to discuss in detail the sampling methodologies that can be adopted. However, some general issues that managers may need to consider regarding sampling are discussed below.

2.   Tests before the census

2.460   Generally, the testing programme before the census will involve sampling particular areas and a proportion of enumeration areas within those areas. For the majority of tests, it is important that, as far as possible, the sample selected be representative of the country as a whole. For example, this will require that areas in both urban and rural localities are selected. Tests that are conducted for specific purposes (for example, to test enumeration procedures for particular population groups) will need a sample selected that contains a representative proportion of people in that particular population group.

3.   During the census

2.461   Sampling during the census is undertaken where it is desired to reduce the costs of the census. Generally, this is achieved by asking a restricted set of questions of the entire population (usually the basic demographic questions on a short form), with only some proportion of households (usually about 10 per cent) asked the full range of questions (long form).[41] In the United States of America, before the 2010 census[42] the sampling rate for the

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[41] In the 2010 round of population and housing censuses, other combinations were documented, such as in Germany, where the total count was applied to all living quarters of the country; the sampling of the population was then used for the production of population census statistics.

[42] Beginning in 2010, the United States replaced the long form with a rolling survey called the American Community Survey. It uses a series of monthly samples to produce annually updated estimates for the same small areas (census tracts and block groups) formerly collected via the decennial census long-form sample.

long form varied between 15 and 20 per cent. In the 1980 census, there was a 17 per cent sampling rate; during the 1990 census, it was 20 per cent.[43]

2.462   Cost savings are generally no more than 20 per cent of the total cost of the census, as the main cost of the census is in finding the households and the households within the enumeration areas. The major saving is in salaries for processing staff. In an interviewer-based census, savings can also be made for enumeration costs because of the reduced time needed to interview the majority of households.

2.463   However, careful consideration should be given before using a short- and long-form approach. The major purpose of carrying out a census is to provide data for the smallest geographical areas and for small population groups; sampling within a census is usually only considered where the demand for the statistics is mainly for larger geographical regions.

2.464   For countries with smaller populations a short- and long-form approach would not be the best option, as the extrapolation of data from the long form would necessitate a significant sample size and, therefore, there would not be significant reduction of costs.

2.465   In the context of countries using a combined method, sampling can be used to collect information that is not available from registers or to correct register data.

4.   After the census

2.466   The post-enumeration survey[44] involves the complete re-enumeration of a representative sample of the census population, and matching each individual who is enumerated with the main enumeration. The post-enumeration survey is designed, to the extent possible, to provide a comprehensive evaluation of coverage and content error. It must therefore be representative of the entire country and of all population groups, thus allowing estimation of coverage error at national level as well as at regional or urban/rural levels.

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[43] Example: percentage of countries using short and long forms in 2010 round based on United Nations Statistics Division survey; size of long-form sample for several countries.

[44] An elaboration of technical issues is provided in *Post Enumeration Surveys: Operational Guidelines*, Technical report, United Nations Statistics Division, New York, 2010.

III. Pre-enumeration operations

A. Introduction

3.1   The present chapter focuses on the tasks required to prepare for the census enumeration. It discusses mapping, questionnaire content and design, testing and evaluating census questions and procedures, preparation of instruction manuals, recruitment and remuneration of census staff, field staff training, and logistics for census materials.

B. Mapping

1. Introduction

3.2   The quality of geospatial data used in the census has a major influence on the quality and reliability of census data. The vast majority of countries have used maps for enumeration. There have been instances where maps have not been available for the census and countries have relied on household and building lists to conduct the enumeration. This has generally been the case in countries where such lists are strictly controlled through administrative procedures and are up to date. However, advancements in technology have led to the almost universal adoption of maps, either in paper or digital format, as integral parts of census taking.[45]

3.3   The enumeration activity should rely on current geospatial data, which play a vital role in guiding enumerators to dwellings and other places where people are likely to be during the enumeration period. Geospatial data may be represented on hard-copy maps or in digital format based on offline and online databases. These data are crucial in ensuring full and unduplicated coverage of geographical areas.

3.4   Similarly, maps, increasingly in digital format, form an important part of the dissemination strategy. Statistics compiled from census data can be geographically referenced and provide for methods of analysing the geographical characteristics of those statistics.

3.5   The tasks and lead times necessary to create, maintain, develop and distribute enumeration area maps are significant. Therefore, careful consideration should be given to the mapping activity during the census-planning and preparation phases. Given the importance of the currency of map data, the mapping exercise should start well in advance of field enumeration, taking note that if the exercise starts too early, the situation on the ground may have changed by the time of fieldwork.

3.6   Prior to developing the mapping programme for the census, consideration needs to be given to the geographical classification to be used and the mapping infrastructure available to

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[45] The United Nations Statistics Division published the *Handbook on Geospatial Infrastructure in Support of Census Activities* (United Nations publication, Sales No. E.09.XVIII.8), New York, 2009, which elaborates in detail the contemporary approach to these issues.

carry out the mapping tasks. Once the maps for a current census are prepared, they also become an irreplaceable input for the next census as well, hence the importance of thorough documentation and storage of the current census maps.

2.   Establishing a business model

2.1   Census agency-based mapping programme

3.7   Regardless of the extent to which advanced technology is used, the development of a mapping system requires the coordination of a series of complex tasks with relatively long lead times. Therefore, it is important that project plans be established to manage this process. In the broadest sense, a mapping programme performed by the census agency requires an in-house mapping unit with a particular set of skills. The shorter the time between the production of maps and the enumeration, the more accurate the maps will tend to be and this factor also has an impact on the size and the functioning of the mapping unit. The activities to be performed by that mapping unit – developing geographical classifications, making use of mapping technology, and managing mapping operations – are discussed in subsequent parts of the present section.

(a)   Establishing a mapping unit

3.8   The census-mapping project requires the services of a specialized project team. Where mapping activities are performed by external organizations, the mapping project teams will be responsible for specifying the requirements of the census for mapping products and coordinating arrangements with the provider of mapping services.

3.9   The mapping timetable will be dependent on several factors. The critical date is the date that maps must be delivered to the field to enable the enumeration activity to proceed. It is therefore essential that the mapping programme commence early in the census cycle to allow sufficient time to produce a national coverage of maps.

3.10   The time required will be dependent on the availability and relevance of pre-existing material, including:

(a) Maps from previous censuses;

(b) The extent of change considered for the mapping systems;

(c) The extent of change in the features to be depicted on the maps (including, as a key element, changes in the size and pattern of population).

3.11   For any proposal beyond the most rudimentary system, significant lead times need to be allocated to this process. Even where a completely clerical system is adopted, the dependency of most other processes in the census on the mapping system requires that it be one of the first processes to be initiated for the census.

(b) Policy considerations

3.12   In cases when a mapping unit has not been established, mapping functions may be distributed throughout the statistical organization, with a mapping specialist in several functional areas. The role of the mapping area in respect to pre-existing mapping capabilities must be clearly established. Especially important is the clear definition of roles for the creation and maintenance of spatial data sets. This extends to the establishment of data-sharing relationships with counterpart agencies. The mapping office should be clear about its intentions to use partner data for either enumeration or data dissemination purposes.

3.13   The mapping office at the statistical organization should be empowered to manage the creation, collection and maintenance of spatial data and to set guidelines for cartographic dissemination materials for the statistical organization as a whole. The mapping office, under the guidance of senior management at the national statistical office, should also work with external data-sharing partners to establish guidelines on the authority to update spatial data sets that may support the census project but are not created or maintained by the national statistical office. Examples of such data sets include high-level administrative boundaries, draining, and street centre lines.

3.14   The role and responsibilities of the statistical agency within the national spatial data infrastructure should also be considered, if such an infrastructure exists. A national spatial data infrastructure is a framework for the creation of policies, procedures and technology that facilitate sharing of spatial data across government, private, non-profit and academic organizations.

(c) Required skills

3.15   Traditionally, the geographers and cartographers working in mapping units had overlapping but distinct skill sets: geographers performed tasks such as devising classifications for geographical areas and analysing spatial demographic trends, while cartographers produced maps used in field and dissemination materials. Increased use of desktop GIS has led to a convergence of these occupations as the time and effort needed to make maps has decreased. Emerging geospatial technology requires a reconsideration of the technical skills held by GIS staff in a national statistical office.

3.16   The skills required to implement modern geospatial technology have evolved. An advanced GIS program requires that staff have the ability to automate GIS operations with the scripting languages used in modern GIS, design databases for storing geospatial data, and build interactive web maps. Hiring individuals with the full range of skills necessary to take advantage of the new technology is difficult, but not all GIS staff at the national statistical office must become experts in all of these skills. Therefore, careful consideration should be given to the distribution of responsibilities among the GIS staff and to the type of expertise needed to fulfil a particular goal. Successful GIS managers will develop areas with varied skills while encouraging cross-area understanding, cooperation and collaboration. Managers should also encourage their GIS staff to conduct independent problem solving and self-teaching, considering the rapidly evolving and highly technical nature of GIS.

2.2   *Contract- or agreement-based mapping programmes*

3.17   The development of mapping capacity beyond rudimentary clerical systems requires considerable knowledge of geography, cartography and digital geospatial systems. In the event that a census agency cannot draw on such skills from within the agency, it may be required to contract out the preparation of census maps.

3.18   Establishing a contract or agreement between the statistical and mapping agencies is based on the specification of the statistical agency's requirements and the mapping agency's ability to meet those requirements at an agreeable cost. In some cases, the production of a complete digitized base map of a country suitable for a census and, subsequently, electoral, postal and other purposes, including commercial ones, may be a sufficient reason for the Government to approve additional funding, on an exceptional basis, to establish the base map. A complete and consistent base map of an entire country suitable for small-scale activities is a high-value national resource. In other cases, a contract or agreement between the agencies provides the opportunity for the mapping agency to consolidate or increase its own mapping skills and capacity while lessening the resource and technical burden on the statistical agency. The two agencies must develop a cooperative and long-term strategic relationship, but the outcome will be worth the effort.

3.19   For the census, a mapping agreement between the agencies would comprise two broad elements: (a) mapping for field purposes; and (b) mapping and map-based products for dissemination purposes. Using the same base map as the common source for both of these elements adds a level of quality assurance and consistency to the census programme that can be difficult to achieve where field and dissemination mapping are two separate elements.

3.20   Mapping for field purposes under a contract or agreement basis requires the statistical agency to specify its requirements of the mapping agency. These may include the following:

  (a) Acquiring the base map data;

  (b) Creating (or obtaining) the statistical boundaries and aligning them with the base map;

  (c) Providing a process for enumeration area designers to advise on changes to boundaries (and updates to associated non-spatial data);

  (d) Producing hard-copy or digitally available maps as specified in the contract terms for fieldwork.

3.21   The statistical agency would undertake the enumeration area design work and validation of the associated spatial data, and take delivery of the geospatial data and maps for quality assurance checks and subsequent delivery into the field logistics programme. The statistical agency would also provide, after the census, any feedback received from enumerators about the base map that may be of use to the mapping agency.

3.22   Mapping for dissemination purposes is more difficult because dissemination products involve representation of statistical information (with, or as part of, a map) and are often

accompanied by analysis or commentary. Advances in mapping software have made it easier for census agencies to produce a wide variety of standard thematic maps.

3.23   However, advanced mapping products may require the expertise of the mapping agency. In these cases, it may be better for the statistical agency to focus on the statistics and let the mapping agency provide the technical skills required to produce the actual products.

3.24   The statistical agency would direct the development of map-based products as part of the overall output plan, taking into account user needs and requirements and the demand for different types of products. For example, it may be established that there is a strong demand for a series of thematic maps showing population change between censuses. The statistical agency would determine how the final maps should look, what standards should be applied (such as colour scales), what analysis should be included and how to present the spatial data. The mapping agency would produce drafts of the maps using the information provided. These would be reviewed, changes made, and so on, until the product was final.

3.   Geographical classification

3.1   Types of data

3.25   A geographical classification should be devised along with the development of census mapping, as the collection geography of the census determines the geography on which the census data can be disseminated. Figure X is an example of the different geographical areas and regions that may be defined for a country. These will depend on the administrative structures of the country and the needs of statistical data users. In this example, the statistical areas are those that have been defined by the statistical agency as being the most relevant for users of statistical information and for which statistical output is generally disseminated. The complexity of the structure of the statistical areas and the nature of the units will vary depending on the needs of the statistical data users. Administrative regions reflect the different levels of government administration in a country and exist independently of the census. Census management areas are defined for managing census enumeration. Other areas are those that are not part of any of the other area structures but for which statistical data may be required. Annex IV shows the geographical hierarchy used by Statistics Canada's Census Program.

3.26   Statistical areas may or may not relate directly to different levels of the administrative regions. However, as the various levels of Government are among the largest users of statistical data, it would be expected that some of the statistical areas would match directly, or aggregate to, administrative regions (in the example above, statistical local areas aggregate to subdistricts and statistical divisions aggregate to provinces). As much as possible, statistical and administrative geography should nest directly.

3.27   Census management areas may or may not relate to either administrative regions or statistical areas, as they are devised to allow the most efficient census collection and effective monitoring of progress on data collection. In countries where the collection is undertaken by

other government agencies, the census management areas may be the same as the administrative regions.

3.28   Statistical outputs may be required for other areas, which may or may not be part of the geographical classification, such as electoral areas or postal areas. Boundaries of the other areas may not match those of constituent enumeration areas or any other statistical areas or administrative regions. Therefore, statistical data for other areas may only be available on a "best fit" basis.

3.29   The definition of the various areas of the geographical classification, their relationship to one another and other issues relating to geographical classification will not be considered in the present handbook, except for those of direct concern to census enumeration, namely the design of enumeration areas and the census management areas.

Figure X

Example of a census geographical hierarchy
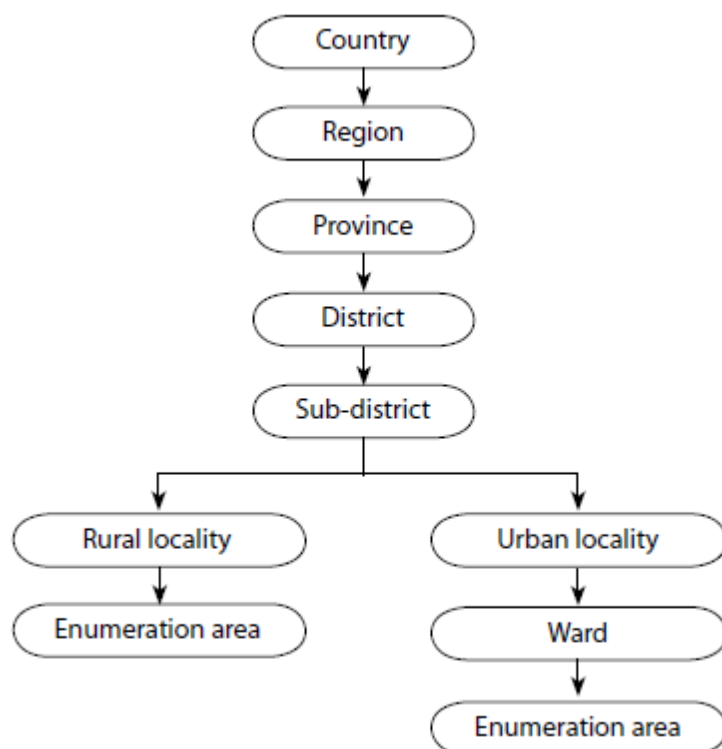
Source: Handbook on Geospatial Infrastructure in Support of Census Activities (United Nations publication, Sales No. E.09.XVIII.8), New York, 2009.

3.2   Enumeration areas

3.30   As figure X shows, enumeration areas are fundamental to both the statistical area structure and the census management area structure. The multipurpose nature of this unit needs to be reflected in the criteria established for setting enumeration area boundaries. This

will be a combination of geographical classification criteria and practical census collection criteria. Issues that need to be considered include:

    (a) Exhaustive coverage of the census area, which is almost always the entire country;

    (b) The ability to manage field operations effectively;

    (c) Enumeration area design;

    (d) Impact of enumeration area design on enumeration;

    (e) Enumeration maps;

    (f) Information for local or regional governments.

(a)   Exhaustive coverage

3.31   Enumeration areas must cover the entire territory of the country, without any overlap or gap. This should include areas thought to be uninhabited, even if the availability of mapping data for those areas is limited.

(b)   Ability to manage field operations effectively

3.32   For enumeration purposes, the enumeration areas should be designed with regard to the workload limits of enumerators to ensure the activity is completed within the planned schedule time.

3.33   To enable effective management of the field operations phase, the determination of enumeration area boundaries should consider characteristics that affect the workload and the time to complete the activity. The following is a list of key factors that should be considered:

    (a) Method of enumeration;

    (b) The process and tools used by the enumerator during the field operations;

    (c) Type of terrain;

    (d) Estimated number of dwellings;

    (e) Density of population;

    (f) Mode of transport for enumerators planned for each geographical area.

(c)   Enumeration area design

3.34   An enumeration area design manual should be produced that contains the design criteria and the procedures to be followed when designing enumeration areas. The manual can be used as a basis of training for those involved in the enumeration area design process, and should include the following:

    (a) Enumeration area design background;

    (b) The role of enumeration areas in both census enumeration and dissemination;

    (c) The definition and explanation of higher-area administrative and statistical boundaries and the part they play in enumeration area design;

(d) The cut-off date for accepting changes to higher-area boundaries;

(e) The procedures to delineate areas by an urban or rural classification;

(f) Enumeration area design criteria, processing procedures and design rules;

(g) Procedures for assigning geographical identification codes and allocating higher-area codes;

(h) The roles and responsibilities of staff involved in the process – the staff could be from the central census agency, regional offices or field operations.

3.35   Using a standard design manual as the basis for training, and as a reference for enumeration area designers and field staff, will play a significant role in ensuring that enumeration area design is approached in a consistent manner.

3.36   Once the base map has been updated for a region and the census agency has determined the criteria for boundary design, the design of enumeration areas can commence. The most suitable approach, if possible, is for staff from the regional statistical office to conduct enumeration area design, with primary responsibility for enumeration areas within their province or regional boundaries. Conducting enumeration area design at a regional office level ensures that local knowledge of geography and population can be utilized in the enumeration area design process.

3.37   Effective enumeration area design will facilitate the design or redesign of area boundaries in response to population fluctuations (usually growth) and administrative or statistical boundary alterations during the intercensal period. A considerable part of the design process is the gathering of information to assist in determining where population and boundary variations have occurred in order to determine the best way to design particular enumeration areas. The information used mainly includes the following:

(a) Legally published boundary changes in each province or regional area;

(b) Indicators of building activity;

(c) Population data from the previous census;

(d) Intercensal population estimates;

(e) Enumerator comments from the last census field operations;

(f) Field inspections.

3.38   Enumeration area boundaries should follow physical features that are easily recognizable in the field by enumerators, improving accuracy and efficiency. These features can include roads, waterways, established walking tracks and railway or power lines. The use of features such as village or local government boundaries, which may be necessary in order to publish data for a small area or for a larger geographical area such as a town, should be carefully considered, taking into account the difficulty of enumerating areas with intangible features such as compass bearings or lines of sight.

3.39   As well as determining the boundaries of the enumeration area, a range of other attributes may be considered in the design of an enumeration area for census management purposes. These could include matters such as defining areas requiring special enumeration procedures (for example, culturally specific procedures applicable to minority groups).

(d)   Impact of enumeration area design on enumeration

3.40   For dissemination purposes, enumeration area design needs to take into account the demand for small-area data and the confidentiality of personal information. An important requirement of any census is not only to meet the small-area data needs of users, but also to present information on various larger geographical units.

3.41   In many cases, it is impracticable to force enumeration area boundaries to aggregate exactly to all possible larger geographical areas. The geographical classification should make clear the higher-level geographical areas to which enumeration areas must aggregate. The design processes and procedures should ensure that this occurs.

3.42   However, for other defined boundary areas, such as postal areas, an approximation of enumeration area boundaries may be used to enable the dissemination of census data against these commonly defined areas.

3.43   There may also be other areas of particular interest to users of census output. These could include distinguishing urban and rural areas, or cultural groups. Therefore, an enumeration area may be classified during the design phase (or after census data are available) as to the degree of urban development or remoteness, or may be coded to an urban centre of which it forms a part.

3.44   An important issue to users of census information at the enumeration area level is the comparability of enumeration areas across censuses. By taking into account enumeration area comparability issues during design, procedures can be developed that will allow a comparability listing of enumeration areas from one census to the next to be produced.

3.45   In cases where this is not possible, the criteria can outline design principles that will allow users to compare enumeration area-based data across censuses. For example, it is preferable to split an enumeration area and create two areas that exactly aggregate to the previous one. This will enable users to easily track the movements of boundaries and perform some time series analyses of the disseminated data. Correspondence tables, which code the relationship between different vintages of the census and survey geographical hierarchy, can be created when enumeration areas are stored in database format.

3.46   Another task that could usefully be done during the design phase is the preparation of concordances that show the link between an enumeration area and higher-level geographical areas. Both external users and the staff within the census agency working on dissemination will find such concordances invaluable in preparing census output products and services.

(e)   Enumeration maps

3.47   Considerations for the preparation of enumeration maps include the following:

(a) Enumerators may not be familiar with their enumeration areas and are not likely to be expert map readers, so the maps must be easily interpreted.

(b) Enumerators may be required to navigate in poor lighting conditions, in particular at night. Screen readability in full sunlight is also a consideration for digital maps.

(c) Folding and refolding of large-format maps (above A2 in size) is inefficient for enumeration staff (including more senior staff).

(d) Maps need to facilitate the addition of handwritten enumerator comments relating to such matters as planning the collection route (blocking), difficulties in navigation, finding new dwellings, and adding or deleting streets. This information can be useful both in quality assurance of the enumerators' work and in subsequent quality improvement of the base.

(e) Production of the maps should be cost-effective.

(f) Statistical boundaries overprinted on the maps must be clear, and unambiguous enumeration areas must be distinguishable when compared with the surrounding area.

(g) The maps should be suitable for dissemination purposes.

(f) Information from local or regional governments

3.48   If applicable, the enumeration area design process should be evaluated from the previous census with a view to improving the process for the current census. Regardless of whether new systems or procedures are employed from the previous census, any evaluation reports or mapping-related feedback must be considered, in particular to determine the accuracy and suitability of previous enumeration area boundaries. Any comments from previous census enumerators, including notations to previous enumeration area maps, should be analysed during the design process.

3.49   There will be occasions when a lack of relevant information for specific areas will require field inspections to ascertain accurate estimates of dwellings or population counts for those areas. Given the high cost of performing field inspections, it is imperative that the requirements of each inspection be well defined prior to departure to ensure that follow-up visits to the same area will not be required.

3.50   The design process must be structured so that all relevant information relating to enumeration areas of a particular region will be analysed, and a systematic update of enumeration area boundaries performed against the design criteria. The update of enumeration area boundaries will be the result of splits or amalgamations of those areas, donations of areas from one enumeration area to another, or realignment of enumeration area boundaries with updated base map features.

3.51   A list should be produced that provides the enumeration phase with all relevant field data for each enumeration area, and the dissemination area with relevant geographical data.

3.3   *Design criteria for census management areas*

3.52   Census management areas will consist of aggregations of enumeration areas brought together for ease of managing the enumeration staff. The numbers of areas and levels in the hierarchy will depend on the structure of the enumeration staff. Where already existing government administrative staff and structures are used for enumeration purposes, the census management areas may be the same as the administrative regions.

3.53   The design of field supervisor and regional and deputy regional manager area boundaries can be determined at the completion of the process through the simple aggregation of enumeration areas, and the subsequent allocation of geographical identification codes.

3.4   *Housing units*

3.54   The *Principles and Recommendations for Population and Housing Censuses, Revision 3*, defines a housing unit as presented in box 17.

Box 17. Definition of a housing unit

A housing unit is a separate and independent place of abode intended for habitation by a single household,[46] or one not intended for habitation but occupied as living quarters by a household at the time of the census. Thus it may be an occupied or vacant dwelling, an occupied non-conventional housing unit or any other place occupied as living quarters by a household at the time of the census. This category includes housing of various levels of permanency and acceptability and therefore requires further classification in order to provide for a meaningful assessment of housing conditions.

The essential features of housing units are separateness and independence. An enclosure may be considered separate if surrounded by walls, fences, and so forth, whether or not covered by a roof, so that a person or group of persons can isolate themselves from other persons in the community for the purposes of sleeping, preparing and taking their meals, and protecting themselves from the hazards of climate and environment. Such an enclosure may be considered independent when it has direct access from the street or from a public or communal staircase, passage, gallery or grounds, in other words, when the occupants can come in and go out of their living quarters without passing through anybody else's premises.

Source: Principles and Recommendations for Population and Housing Censuses, Revision 3, paras. 4.427 and 4.428.

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4.   Mapping technology

3.55   Before census mapping can commence, the census agency needs to determine the appropriate technology to be used for mapping. A range of different systems can be used to produce maps for use in the census. At a base level, an agency can either produce hand-

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[46] Although intended for one household, at the time of the census, a housing unit may contain multiple households.

drawn maps of enumeration areas, or source hard-copy geographical maps that would allow enumeration areas to be clerically designed and represented. Hand-drawn maps, usually called sketch maps, are pictographic representations of an enumeration area. By definition, sketch maps are not made to rigorous cartographic standards, and must be redone for each census or survey. Alternatively, a GIS could be implemented. By the 2020 round, it is expected that most countries will have implemented a GIS for census mapping in some capacity. GIS provides a computer-based design of enumeration areas and significant automation of map production tasks. Agencies should refer to the United Nations publication *Handbook on a Geographic Information System and Digital Mapping for Population and Housing Censuses*, which contains further details on GIS mapping. [47]

4.1 Geographical information systems

3.56   The use of GIS has become the standard for mapping operations at national statistical agencies, facilitating census mapping. GIS can be expensive and complex to maintain and operate. However, the cost of GIS must be compared with the costs of redoing sketch maps for each new census or survey. Adoption or expansion of GIS capabilities should be seen as a major strategic decision, and when looking at the benefits or otherwise of introducing GIS applications many issues need to be considered. Determining the overall cost benefit of introducing new or updated technology into the mapping project will be influenced by many factors, most of which will be specific to the situation existing in each country at the time of drawing up census plans. Issues to be considered include:

   (a) The relevant technical skills base in the census agency (or within other businesses or agencies that are able to contract services to the census agency);

   (b) The computing infrastructure within the census agency or that can be made available to the census agency under contract;

   (c) The availability of maps or digital geographical data to be used;

   (d) Determination of the functions that will be performed within the census agency versus those that will be outsourced;

   (e) The cost of hardware, software, maintenance and training;

   (f) The cost and time of updating base maps and boundaries, which will be directly related to the size of the country in terms of both the spatial area of the country and the size and distribution of the population within the country. This may involve a one-time cost, with considerable benefits for later censuses, including possible time savings in performing mapping activities for later censuses.

3.57   While there are many advantages for a country using GIS for its census, these need to be carefully weighed against the prerequisites for the successful implementation of GIS. The

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[47] *Handbook on a Geographical Information System and Digital Mapping for Population and Housing Censuses* (United Nations publication, Sales No. E.00.XVII.13), New York, 2000.

alternative to a completely GIS-driven mapping programme is a hybrid model that retains one of the more traditional forms of a clerical-based mapping system.

3.58   In terms of the points raised above, examples of the challenges of the use of GIS include the following.

    (a) GIS requires a significant level of technical expertise, whereas the traditional systems utilize skills more readily available in most countries.

    (b) By definition, GIS will require a higher level of computing infrastructure than will a clerical-based system. One of the benefits of GIS – namely, a closer linkage between maps or enumerators and map-based products for users – requires that users, as well as the census agency, have the computing infrastructure to utilize the output of GIS. For the census agency to take the lead on this issue is a significant step towards using the census as a catalyst for an overall national advance in capacity.

    (c) A clerical census system can proceed on the basis of rather rudimentary maps (for example, relatively old maps from an administrative system supported by sketch maps prepared by the enumerators in the field). However, use of GIS in this task requires that a digital map base exists and can be used for census purposes. If it is necessary to create the digital map base, significant lead times are required, as well as significant funding.

    (d) In most cases, the preparation of maps or use of GIS will not be the core business of a statistical agency. It will therefore be necessary for the census agency to determine which of the functions it will undertake and which will be outsourced. This decision is of strategic importance in determining the direction of a country's census effort.

3.59   On the other side, the use of GIS has significant advantages that are not limited only to the preparation of enumeration maps, such as the following.

    (a) Producing duplicate maps, including hard-copy maps for dissemination, would be less expensive with a GIS solution.

    (b) Space needed to store input maps for digital purposes will be far less than with a clerical system.

    (c) GIS will have increased ability to undertake quality assurance of geographical boundaries.

    (d) The census agency will have a greater ability to perform spatial queries against the geography database under GIS.

3.60   Box 18 presents further information on the costs and benefits of GIS.

Box 18. Defining geographic information systems and understanding the costs and benefits

A GIS can be seen as a system of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modelling and display of spatially referenced data. In practical terms, such a system may range from a simple desktop mapping facility to a complete GIS system that is capable of solving complex planning and management problems or producing detailed georeferenced inventories. Its ability to use space to integrate and manipulate data sets from heterogeneous sources can make its application relevant to planning and managing the census process itself. For example, a GIS provides functions for the aerial interpolation of statistical data in cases where the boundaries of aerial units have changed between censuses. However, the development and implementation of such a repository of georeferenced data are not easy tasks to accomplish, and simple desktop mapping systems generating thematic maps from a database of base maps and indicators will satisfy the needs of most census organizations.

The (potential) benefits and costs of GIS are summarized as follows.

Benefits

- A closer linkage can be achieved between maps for enumerators and map-based products for users.

- Enriched dissemination of census data is possible, as they can be visualized in geographical areas for easy understanding by users.

- The cost of intercensal updating of the base map will be less with a digital base map, enabling among other things the construction and updating of sampling frames.

- Producing duplicate maps may be less expensive with a GIS solution.

- GIS will have increased ability to undertake quality assurance of geographical boundaries.

- The census agency will have a greater ability to perform spatial queries and advanced analysis under GIS.

- Space needed to store input maps for digital purposes will be far less.

Costs

- GIS requires additional technical expertise.

- GIS will require a higher level of computing infrastructure.

- A clerical census system can proceed on the basis of basic maps. However, use of GIS in this task requires that a digital map base exists. If it is necessary to create the digital map base, significant lead times are required as well as significant funding. In both cases, more experienced technical staff are required.

- In most cases, the preparation of maps or GIS will not be the core business of a statistical agency.

Source: Principles and Recommendations for Population and Housing Censuses, Revision 3.

4.2   *Field data collection and global positioning system*

3.61   Handheld devices have been in use for geographical listing activities since the 1990s,[48] when field portable GPS technology became widely available. These devices have contributed to the improved accuracy of digital GIS data. Today, purpose-built GPS devices can usually collect accompanying geographical attribute data. However, the attribute data collected by a standard handheld GPS device may not support the complexity of data captured for a census. Handheld GPS devices are best used for collection of the location of housing unit points.

3.62   The use of handheld devices for census data collection involves two related but distinct types of technology: (a) electronic versions of the census questionnaires; and (b) a user interface and processing engine for the manipulation of spatial data. The emergence of tablets and smartphones that incorporate GPS technology enable both collection of census data through an electronic version of the census questionnaire and the collection of geographical data with complex attributes.

3.63   Custom tablet and smartphone data collection applications, when driven by geographically enabled software, can access and manipulate all types of geographical data (points, lines and polygons) on screen with a base map (satellite imagery or reference map) for field user orientation. Such applications can collect data to split building point data sets into individual living quarters, capture the number of housing units, and collect household-level data.

3.64   Point data are relatively easy to collect and manipulate on handheld devices. However, manipulation of boundaries in the field adds a substantial level of complexity to both the listing program and the workflow for reintegrating data collected in the field back into the geographical hierarchy. Reintegration of linear or polygon data manipulated in the field requires an advanced workflow that ensures that the geographical characteristics of the nested boundary hierarchy is preserved. Furthermore, if multiple users are editing these data simultaneously, an enterprise GIS solution may need to be acquired (discussed in subsection 4.4 below) to effectively manage the flow of data. A simpler solution for national statistical offices to consider is to use up-to-date high-resolution imagery for most enumeration area boundary updates.

3.65   In situations that still require hand-drawn maps in the field, this process can be greatly assisted by GPS. A simple, handheld GPS receiver will provide latitude and longitude accurate to about 3 metres. Greater accuracy is available with differential receivers where differential corrections are available. A hand-drawn map can be greatly enhanced by the addition of latitudes and longitudes recorded at a few key points on the sketch to provide orientation, scale and absolute position. Alternatively, some receivers allow the operator to

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[48] The first commercially available GPS receiver was the Magellan Nav 1000, released in May 1989.

log electronically positions and comments while traversing an area on foot or in a vehicle. This technique can quickly produce a relatively accurate map.

4.3   *Digitization with satellite imagery and overlay*

3.66   Although relatively expensive to acquire, a satellite image typically covers a large area and can be cost-effective compared with other sources. It is also possible to stream satellite imagery through Internet services made available by several commercial GIS companies. Streamed imagery can be used for digitization via visual interpretation, but it is not possible to perform advanced analysis on streamed imagery. Imagery should be preprocessed by the supplier so that it is rectified and georeferenced (that is, a known scale and orientation, with some latitudes and longitudes, printed on the face of the image).

3.67   While acquisition of aerial photographs for large tracts of a country is expensive, existing archives of photographs can be an excellent resource for both population and preliminary counts of dwellings, and as a base for rudimentary maps. It should be remembered that aerial photographs have distortions owing to variations in height of the terrain and are only approximately oriented to compass bearings. Scaling, orienting and integrating the boundaries of adjoining enumeration areas will be, at best, imperfect.

3.68   Paper maps sometimes include building points, but digitization of building points from paper sources rarely provides an acceptable level of locational accuracy. For an accurate digitization of building points, staff at the national statistical office can use satellite imagery to capture building points in the office while handheld GPS technology can be used for field verification. The combination of these two types of technology can reduce the amount of resources required for building listing. These techniques make it possible to capture building points rapidly and to work around the lack of an address system. However, distinguishing between living quarters and non-residential buildings, as well as registering individual housing units, still requires fieldwork.

3.69   Where topographical maps of reasonable quality are available, they should be used as a base; hand-drawn enumeration area boundaries can be added as an overlay. The resulting maps may not be of cartographic quality, but enumeration area boundaries will at least be oriented and scaled relatively accurately and the major difficulties of relating one sketch map to another will be mostly overcome. Boundaries and other census information can be digitized for field use or separated for other purposes.

4.4   *Enterprise geographic information systems*

3.70   The decision to migrate to an enterprise GIS for use in the census should be made early. Enterprise GIS refers to the management of spatial data at the level of an office or organization. An enterprise GIS ensures data flow easily between teams and individuals without compromising data quality or security.

3.71   An enterprise spatial database (or geodatabase) can store and manipulate spatial data and is typically accessed through a relational database management system. This database

could be accessible within a specific working group (such as the GIS staff) or it could be available throughout the national statistical office and possibly via a secure Internet portal.

3.72   National statistical offices will have to decide between either proprietary commercial software or free and open-source software when implementing their enterprise GIS framework for the geographical listing operation. As shown in table 7, each option has strengths and weaknesses. National statistical offices should discuss these software considerations with their staff (if keeping development in house) or chosen vendor (if outsourcing) early in the project. Regardless, for both open-source and proprietary software, national statistical offices must ensure that the enterprise GIS can be maintained over the entire census or survey project life cycle and beyond.

Table 7

Key distinctions between free and open-source software and proprietary commercial software

	Free and open-source software	**Proprietary commercial software**
Licensing fees	None	May have up-front fees or annual maintenance fees
Source code	Complete access, providing greater customization options for software developers; not all free software is open source	Not open to the public and protected by copyright
Ease of use	May be heavily reliant on command line interface and user programming knowledge, requiring more expertise	Typically a user-friendly graphical interface, requiring less expertise
Technical support	Limited to online user community; dedicated support possibly available for purchase from private vendor	Typically available directly from software publisher

3.73   Open-source and proprietary software can be used for different components of the enterprise GIS. Many of these components are interoperable, meaning a national statistical office could use an open-source solution for one component but a commercial solution for another, depending on the workflow requirements.

3.74   The solutions discussed above are typically hosted by national statistical offices with on-site servers or through a cloud service and require direct management by the national statistical office or a contracted vendor. However, GIS as a service offers an emerging set of alternative solutions worth considering. These solutions are a hybrid of database, server, and web map, and offer varying degrees of functionality. Potentially, a GIS as a service solution can reduce the human and physical capital required to host geospatial data and reduce operational costs. However, GIS as a service provides less control and customization than an

on-site server solution and may be preferable for the dissemination phase of the census or survey life cycle rather than the operational phase.

4.5 Hand-drawn maps

3.75 In circumstances where it has not been possible to acquire appropriate base maps for areas of geography, there may be a need for enumerators to produce hand-drawn maps to enable successful enumeration. Hand-drawn maps created in the field are generally pictographic and lack the accuracy of a map created by a professional cartographer or printed from a GIS, but are a viable option when:

(a) No map exists for an area;

(b) The available maps for an area are at too small a scale to provide sufficient detail for an enumeration area map;

(c) The available maps for an area are considered seriously out of date and inappropriate as input into enumeration area maps;

(d) During the enumeration period, an enumeration area map proves to be so out of date that it is deemed to be more efficient to draw a sketch map rather than annotate changes to the enumeration area map provided.

3.76 Accurately sketching the shape and extent of an enumeration area in the field requires a great deal of skill and practice. Even where such skills are available, the resulting hand-drawn maps are almost impossible to relate to each other to obtain an overview of an entire region or country. Except in cases when enumeration maps are deemed to be completely out of date upon arrival in the field, the use of hand-drawn maps needs to be considered very carefully against the benefits and costs of requesting that an area be subject to a new survey to enable the production of an accurate base map.

5. Managing the mapping operation

5.1 Choosing map products

3.77 The mapping programme associated with a census is among the most daunting, costly and technically demanding of all census activities. With the exception of hand-drawn mapping, which is an activity usually carried out by enumerators in the field, census mapping has two broad components: statistical and technical. Managing a modern census-mapping operation requires careful planning, attention to data acquisition, consideration of how updates to digital map data will be performed, quality control, and consideration of the map products that will be generated throughout the operation.

3.78 There are many ways of organizing the census-mapping programme, from the census agency undertaking the entire programme to outsourcing almost the entire map preparation and production. The major difficulty for a statistical agency is having a good basis in one area (statistical) combined often with a lack of skills in another (technical). The decision to outsource all or part of the mapping operation should be made on the basis of the skills and

infrastructure possessed by the national statistical office and the availability of those skills in the national private marketplace.

3.79   Many countries have an agency that provides mapping services to the Government and the community. The mapping agency will usually cover a broad spectrum of mapping, including elevation, minerals, mining and land use, but often will not be involved in large-scale mapping of areas for social purposes (such as street directories and censuses). The exception is where a country has developed a land titles system; however, the output of such a system may not be suitable for use in the field.

3.80   A census can provide a catalyst for the statistical and mapping agencies to work together to the benefit of both agencies and the community. Statistical agencies are usually not the authoritative source for cartographic data. However, they increasingly play an important role in the digital data ecosystem owing to their need for continually updated physical features and administrative boundaries. Mapping agencies are unlikely to perform the pre-census operations necessary to prepare spatial data for use in the census. Statistical agencies must plan either to increase the skill set of their geographers or to outsource a significant amount of cartographic work.

3.81   Box 19 provides a description of a census-mapping programme in India.

Box 19. Description of a census-mapping programme: mapping activities in the Indian Census Organization, Office of the Registrar General and Census Commissioner, India

Two kinds of maps are prepared by the Indian Census Organization:

- Maps for use in the census (pre-census);

- Maps for use in data dissemination (post-census).

Census mapping provides an accurate geographical frame to ensure distinctiveness of units of enumeration. As a prerequisite before census taking, the jurisdictional boundaries are frozen. Various level of territorial units are clearly delineated and their maps are secured, according to which census is to be conducted. The maps help to clearly demarcate the boundaries of the country, as well as its division into provincial territories and further subdivision into districts and, finally, the smallest enumeration areas of villages and towns. The Census Organization ensures that the maps represent the latest position of administrative jurisdiction, and that all changes notified by the state government with regard to the boundaries of villages, municipalities and other units are properly accounted for. These maps enable the census officers responsible for enumeration of the territory to clearly identify the dividing lines of their jurisdictions. The purpose is to ascertain that the units of enumeration are not overlapping and that they are collectively exhaustive. The maps are used in each phase of census taking, including the house listing operation and population enumeration.

Post-census mapping includes dissemination of the census data through thematic maps on various census themes at state, district, subdistrict and village levels, allowing accurate spatial analysis. They are published in various map products, such as the census atlases and districts census

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handbooks. During each census, the organization produces more than 10,000 administrative and thematic maps, which are made available for user agencies, planners, researchers, students and policymakers. Decennial publications of the Indian Census Organization include census atlas, administrative atlas, language atlas, historical atlas of India (and of each state) and map profile.

Updating the GIS tools, which were first introduced and adopted in the Indian Census Organization in the late 1990s, has speeded up the process of producing maps and enhanced their quality. The Census Organization has the capability and the infrastructure to generate theme-based maps using GIS, but for use on the Internet it was considered important to look for appropriate technology. The creation in 2001 of Census GIS India was a major step in this direction, as it allowed the generation of interactive thematic maps based on census data using GIS technology. Supportive software was developed and is available on the census of India website. It enables the generation of thematic maps based on the results of the 2001 census, free of charge. These maps have become very popular among government departments, non-governmental organizations, universities, researchers and other data users. This software has assisted in demystifying GIS and has become a user-friendly tool for the analysis of census data using GIS technology on the Internet.

Source: Office of the Registrar General and Census Commissioner, India, http://censusindia.gov.in/2011-common/map.html.

5.2   *Geographical data acquisition*

(a)   Background

3.82   One of the major steps in the mapping project is to establish a map base of the country through the acquisition of various forms of maps. The majority of these sources will be in digital format. In general, a census agency will be required to source maps or digital geographical data from external organizations. If a census-mapping project has already been established, the agency may still be required to source updates to their existing map holdings. The compatibility of data from different sources must be verified as part of the census-mapping project.

3.83   The availability of maps and digital data will determine the suitability of using clerical or GIS methods for the various mapping activities that will be undertaken.

(b)   Basic mapping data

3.84   Official published maps and digital geographical data may be available from national or provincial government mapping agencies, the local government or municipal bodies. Special attention and coordination will be needed where a country's mapping infrastructure is provided through a network of regional organizations.

3.85   Other sources of maps may be other government agencies or private companies. These may include agencies or companies involved in the following areas:

   (a) Public utilities, such as power, water, telephone or gas services;

   (b) Ministries of transport, defence or the environment;

   (c) Oil or other mineral exploration companies;

(d) Air, rail or road transport providers;

(e) Automobile associations, which may maintain maps of the road network;

(f) Commercial cartographic firms and providers of aerial photographic services.

3.86   Where the maps are obtained from sources outside the census agency, permission to use the maps collected must first be sought from the original source, and any copyright issues addressed. Offering an assurance that the maps will only be used for census purposes will often promote cooperation from mapping agencies, while particular care should be taken when negotiating with non-governmental sources.

3.87   The types of maps that may be printed or required for census mapping include the following:

(a) Small-scale reference maps for use in the census agency to manage the overall operation;

(b) Relatively large-scale maps with detailed transportation, building, or land parcel data for use by enumerators, focusing on a single enumeration area;

(c) Maps of the subregions or administrative areas above the village level (or its equivalent) for the use of supervisors and regional managers, showing the location of villages or small population settlements and dominant physical features such as rivers, ridges and forest areas that identify the type of terrain.

3.88   In the case of digital maps, all of these data layers may be available in a single application, with the spatial extent of the layers and the number of layers available limited according the role of the fieldworker (enumerator, team leader, or supervisor). It is important that each map be relevant for its purpose. This requires that the maps for enumerators are of sufficient size to allow all significant text to be readable in field conditions, in poor lighting for printed maps and bright sunlight for digital maps. Maps for supervisors or regional managers should provide sufficient detail to identify major features but not be so large as to be impossible to manipulate easily while, for example, answering a phone call from an enumerator. In many cases, the use of inset or supplementary maps may be required if the map is to cover a relatively large area. An on-screen application with layers that are variable and visible, based on their role, can also fulfil this requirement.

3.89   To complement topographical maps, or in the absence of maps for an area, it may be advantageous to source remote-sensing material such as aerial photographs or satellite images to assist in the preparation of enumeration area maps. However, the cost of obtaining such material, especially satellite images, and the time and expertise required to interpret them, is likely to be extremely high and should be carefully assessed against any benefits of using them. Streaming imagery services can also be used to aid enumerator navigation and map interpretation for digital mapping applications.

3.90   Box 20 describes how a geocoded register of addresses can assist in the preparation of precise census maps.

Box 20. Use of geocoded register of addresses: a contemporary approach

In an increasing number of countries, the development of a register of all addresses with attached geographical codes provides advantageous input for the preparation of very precise census maps. Combining different layers of geographical and infrastructure features with the geocodes from the address registers enables the creation of maps showing the precise location of dwellings relative to the surrounding features. This approach can be optimized by the use of mobile devices for enumeration, as they enable precise census enumeration maps to be uploaded, thus minimizing the time needed to locate housing units within the enumeration area.

(c)   Digital geographical data

3.91   A major consideration in developing a computer-based mapping system, even in developed countries, is the determination by the census agency of data requirements. In determining these requirements, due note should be taken of what data already exist, and plans to enhance that supply should only be made where a long lead time is available before the census.

3.92   In general, the digital data needed will be in the form of boundary, topographical and cultural features, and made up of both geographical (spatial) and attribute (aspatial) elements. The prime purpose is to obtain the best available mapping of dwellings. A common goal for the 2020 round of censuses will be to map the position of every building in the country. Building point data enable customized small-area tabulations but, again, this project should only be undertaken when there is considerable lead time before the census. In cases where building point data are not available, some other indicator of human occupation should be used. Where a system of recording land ownership exists, land parcel boundaries can be a good indicator, with small parcels of land indicating larger populations.

3.93   With increasing amounts of digital data becoming available, it is also important that standards and a common data specification be produced to ensure data validity and consistency. This will also assist in the integration of data sets from different sources. Metadata should be recorded according to the most recent standards set forth by the ISO.

3.94   A wide range of data items could be considered for inclusion in a census-mapping database. As it is likely that data items will vary considerably between countries, no list of items is suggested here. However, the key rules to be followed in selecting data items for inclusion are to question whether:

   (a) The data item will be useful to enumerators in navigating their way around their enumeration area;

   (b) The data item is relevant to users.

3.95   Data items that meet neither of those criteria should not be included in the database. Where possible, data items applicable to a single purpose should only be shown in the maps prepared for that purpose, even though both purposes may be satisfied from a common database.

3.96   The establishment of a digital census-mapping database requires the development of a common data specification that will allow data providers to manipulate their digital data into a form useful to the mapping system, and to enable the integration of digital data from differing sources. In determining a data specification, the following issues should be addressed:

   (a) The digital format, or formats, acceptable to the organization;

   (b) The transfer media acceptable, for example removable media or download;

   (c) The datum and projection;

   (d) The required or acceptable levels of detail, given by the scale of the input mapping, for geographical areas;

   (e) The delivery units;

   (f) The table structure for each required feature type;

   (g) The data attributes required for each feature;

   (h) The symbology for each feature.

3.97   The specification of a single digital format is desirable, as this would alleviate the need for any reformatting of data. Using a range of formats will require significant resources to be dedicated to data reformatting and integration. This format should also specify the datum and projection to be used. The type of media used to receive the data will need to be compatible with the systems deployed for storing and manipulating the digital data.

3.98   In addition to the data specification, containing the feature types required by the mapping system, the geographical data storage schema should specify the attribute data required and the symbology for each individual feature type. Attribute data are important, not only to present named features on a map, but also for differentiating between features. Attribute data should consist of names, identification codes, feature codes, use classifications, mapping source and scale, and mapping dates. Symbology should refer to line types and weight, line and fill colours and cultural symbols.

3.99   Consider that digital cartographic data are now available through free and open sources. Free and open-source data have no cost or restrictions on use or distribution. Open-source data must be carefully evaluated for completeness and compatibility. A statistical organization may consider making some of the geographical data produced for the census freely available to the global user community.

5.3   *Update operation*

(a)   Preparation of base maps (managing edit workflow)

3.100   The activities associated with updating base maps or base digital data require substantial resources to be managed over a long period. The final content of base maps will

have a major bearing on the accuracy and completeness of enumeration area maps and, subsequently, the effectiveness of census enumeration.

3.101   The updating of base maps should be scheduled according to the overall census timeline and priority areas that may have undergone significant population change, regardless of whether mapping is performed by the census-mapping unit or externally. As the principal purpose of all census mapping is to produce maps to collect information from people, or to depict the outcome of such a collection of information, it is suggested that areas expected to have substantially altered population characteristics receive priority. Thus, the task of setting priorities requires the census agency to identify areas in which there has been (or will be by census day) the greatest degree of change in the population since the base map was last updated.

3.102   An important consideration when evaluating maps is appropriateness of scale and the associated detail shown. Primary source maps require appropriate features to be shown if they are going to be useful in producing meaningful enumeration area maps that will assist enumerators. Important features include:

(a) Accurately named and presented roads and waterways;

(b) Administrative boundaries;

(c) Landmark features, such as schools, religious establishments, post offices, parks and large buildings.

3.103   They also need to be accurate and readable, including the location of buildings, if available, with text and symbols readily identifiable and correctly placed, along with the information being presented in a standard format compared with other source maps. The final, and most important, quality indicator is whether data on the map are up to date.

3.104   The outcome of the base map preparation and update activities should be accurate, relevant base maps that will allow for the design of enumeration area boundaries and the subsequent production of enumeration maps.

(b)   Quality assurance during update

3.105   Quality assurance should be implemented to ensure that data are as correct as possible. Examples of this include ensuring that:

(a) Enumeration area boundaries do not cross administrative or statistical boundaries;

(b) Enumeration area boundaries have been drawn correctly and are complete;

(c) Design has been done according to enumeration area design criteria;

(d) The enumeration area list contains all data items and geographical codes for each area.

3.106   It is usually not necessary to check all design work that has been done in this process. Traditionally, initial design work is checked at a higher rate. Once the enumeration area designer gains more experience, the check rate can be moved to a lower continuing base rate.

Cartographic data from outside sources must be integrated with any pre-existing digital data. Procedures for incorporating the external data should follow the above guidelines.

5.4   Integration of mapping with household-listing operation

3.107   An important decision when managing the census is whether the household-listing operation will be integrated with pre-census mapping. The household listing, sometimes called the pre-census, involves a brief questionnaire and possible capture of the location of each household in the country. When the location of each household or dwelling is captured as point locations, the listing becomes a geospatial operation. These points may be captured on paper maps, using handheld GPS devices, or on GPS-enabled smart devices integrated with an enterprise geodatabase.

3.108   The geospatial and basic population data collected during the listing operation can be used to update enumeration maps. Updates may include the creation of new enumeration areas, especially in the context of growing informal settlements, splitting of areas where growth has occurred, and merging where population has contracted. The points captured during a geospatial household-listing operation can provide the basis for a clerically or technologically based operational control system during field operations.

5.5   Map production and dissemination

3.109   Maps should be provided to every level of field staff. The different levels of field staff will require maps of different scales, with different layers of data visible.

3.110   At least one map must be printed or made available via a digital device for every enumeration area in the country. When using paper, two copies of the map have to be produced, one copy to be used by the enumerator and the other by the field supervisor for training and reference purposes. A larger-scale map for supervisors showing all of the enumeration areas in their areas of responsibility should also be made available.

3.111   Maps should also be made available for regional managers showing the areas they are responsible for and the areas for which each of their subordinates are responsible. Such maps are an essential part of the managerial tools provided to the regional manager by the census agency.

3.112   It should be noted that regardless of whether clerical or GIS processes are used, this task can take a significant amount of time and will be performed relatively close to the end of the project. If a mapping application is developed, this lead time must be added to the time necessary for the preparation of data. Careful consideration should be given to the time required for this work when establishing the project plan for census mapping.

5.6   Dissemination maps

3.113   It may be decided to produce a separate set of dissemination maps if the enumeration maps prove to be too detailed and cumbersome for use by statistical data users. The digital boundary data used to create the enumeration and supervisory maps can be made available

for download. It will generally be cost-effective to produce these maps at the same time as the enumeration maps. In general, data users require maps to understand how the enumeration areas fit together and combine to form higher geographical levels. While data users are less concerned about topographical details, sufficient details need to be retained in publicly available data sets to allow the boundaries to be readily identified, as well as the presence of social and cultural features, such as schools, hospitals and major retail and work areas.

3.114   While mapping for enumeration purposes rightly receives the highest priority and attention from census managers, it is imperative that the needs of dissemination are accommodated in the process. This may prove to be cost-effective and may provide flexibility for the use of the mapping data for other purposes. When producing dissemination maps, remember to:

(a) Use a format that is widely used within the country so that output products can be prepared readily to meet a wide market;

(b) Consider the suitability of the data for commonly available desktop mapping applications, including interactive web-based technology for producing maps on demand. The map database for preparation of enumeration maps may be large and detailed and may present problems for desktop mapping use. In this case, a program to thin the data set may be required.

C.   Questionnaire content and design

3.115   The purpose of the census questionnaire is to capture data. A well-designed questionnaire captures data efficiently and effectively, with the minimum number of errors. It would be possible to devote an entire handbook to the principles associated with questionnaire content and design, but for the purposes of the present handbook, some fundamental issues are discussed in the sections below.

1.   Census questions

3.116   There is broad consensus on the items often included in a census questionnaire:

(a) Persons living in housing units;

(b) Persons living in collective living quarters;

(c) Households;[49]

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[49] "The concept of "household" is based on the arrangements made by persons, individually or in groups, for providing themselves with food and other essentials for living. A household may be: (a) a one-person household, that is to say, a person who makes provision for his or her own food and other essentials for living without combining with any other person to form a multiperson household; or (b) a multiperson household, that is to say, a group of two or more persons living together who make common provision for food and other essentials for living. The persons in the group may pool their resources and may have a common budget; they

(d) Housing units;

(e) Dwellings;

(f) Buildings.

3.117 A good starting point for developing a census questionnaire is an evaluation of data, experiences and practices from previous censuses. Data and overall information from previous censuses play a crucial role and need to be thoroughly examined before embarking on the process of changing or otherwise altering census questions.

3.118 The *Principles and Recommendations for Population and Housing Censuses, Revision 3*, draws from international experiences to provide recommendations for core and non-core topics for population and housing censuses. It may also be helpful to draw on the experience of other countries by obtaining examples of forms used in previous censuses. Census questionnaires from other countries are available on the United Nations Statistics Division website.[50] However, caution should be exercised when examining questionnaire design and question wording from other countries. This is because a particular question wording that works in one country may not necessarily work in another country. Even within a country, various regions may require questions to be worded differently to elicit the same information, owing to the cultural differences that exist in the country.

3.119 The wording and format of questions will influence how well the questionnaire works. Issues that need to be taken into account when designing questions include:

(a) Data needs of users;

(b) Level of accuracy and detail required;

(c) Availability of the data from the respondent;

(d) Appropriate language that is easily understood by respondents and interviewers;

(e) Data item definitions, standard question wording and any other relevant information;

(f) Data-processing system being used;

(g) Sequencing or order of questions;

(h) Space required for each answer;

(i) Classification of certain topics;

(j) Acceptability of the question in terms of culture and tradition;

(k) Provision of the census legislation;

(l) Sensitivity of the question.

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may be related or unrelated persons or constitute a combination of persons both related and unrelated" (*Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 2.33).

[50] http://unstats.un.org/unsd/demographic/sources/census/censusquest.htm.

3.120   A general principle in writing questions is that precoded responses should be used as much as possible. Open-ended questions should be limited to essential topics such as occupation and industry or other sensitive questions, such as ethnicity or religion, if included in the census.

3.121   An important issue to consider when deciding on questionnaire content is respondent burden. Minimizing respondent burden will assist in obtaining accurate answers to the questions on the census questionnaire. The length of the questionnaire, the number and type of questions, and how easy the questionnaire is to complete can all add to respondent burden. Respondent burden should be kept in mind when designing the census questionnaire and is particularly important if the self-enumeration method is used. In this context, the inclusion of a certain question, aside from the burden to respondents, needs also to be assessed in terms of the burden to the budget – whether the cost of the question matches the importance of the content.

3.122   Another factor to note is language diversity (box 21). For example, Indonesia has 300 spoken languages and India has over 1,600 spoken languages. This proliferation and diversity of languages has a direct effect on the questions to be asked, the methods and techniques used to train field staff, and the census management structure and questionnaire preparation. This may require the questionnaire to be provided in more than one language. In addition, field staff may have to be trained to translate the questions into the regional languages or dialects spoken in the area. In 2011, India canvassed questionnaires in 16 languages and prepared training manuals in 18 languages.

Box 21. Use of different languages in the census

Special provision will have to be made if two or more languages are used in the country. Several methods have been used to deal with this situation, such as: (a) a single, multilingual questionnaire; (b) one version of the questionnaire for each major language; or (c) translations of the questionnaire in the various languages available in the enumerator's manual or on the website for the census. Information on the distribution of languages in the country is important for sound census planning and, if not available, will have to be collected at some stage of the census preparations. Staff recruitment and training procedures will also have to take language issues into account.

Source: Principles and Recommendations for Population and Housing Censuses, Revision 3, para. 3.29.

3.123   If an electronic questionnaire is used, the software specification could allow for switching between languages on the same mobile device. This has to be part of the planning and design consideration for data capture in a multilingual country.

2.   Type of census questionnaire

3.124   The enumeration and data-capturing methods will determine the type of census questionnaire that needs to be designed. If an interviewer-based method is to be used, then the forms should be designed with the ease of use by the enumerators in mind. If the census will rely on self-enumeration, then the forms need to be designed with sufficient instructions

for a household member to complete on their own. An electronic questionnaire will need to be designed if using self-enumeration using the Internet or computer-assisted personal interview (CAPI) to capture data.

3.125   Furthermore, if the paper questionnaire will be scanned for data capture, then the questionnaire will have to be designed with the scanning requirements in mind. Annex V includes examples of forms used with differing requirements for data capture. India is an example of a system that uses intelligent character recognition (ICR), while New Zealand represents a system using optical mark recognition (OMR).

3.   Questionnaire layout and design

3.126   The questionnaire layout will depend on the type of question, the mode of the questionnaire (paper, electronic), and processing system requirements. Further, interviewer or respondent perception of the questionnaire should be considered when designing the questionnaire. If using an electronic questionnaire, then specifications are needed for designing the data capture program.

3.1   Type of question

3.127   The type of question will influence the layout of the questionnaire. The questionnaire layout may vary depending on whether the questions are about the household or individual members of the household.

3.128   A questionnaire with questions about individual members of the household can be arranged in a table format that fits information about all household members (in most cases) on one page, with each row representing one household member. Another approach to the design of such forms is the use of a booklet, with all of the personal questions asked first for person 1, then repeated for other persons in the household on subsequent pages. The column format is often used for collecting household-level data such as housing type, access to water, electricity and sanitation, ownership of consumer goods, or use of the Internet. Annex V contains the questionnaire used in the 2010 United States of America census, which is an example of a questionnaire designed as a booklet. The census questionnaire used in Kenya in 2009 is an example of a questionnaire arranged in a box format. The questionnaire used in South Africa in 1996 is an example of a column format.

3.2   Processing system requirements

3.129   Differing requirements for the data-capturing components of processing systems, ranging from key entry to electronic imaging through scanners to handheld data capture, will require markedly differing questionnaire designs. The questionnaire design requirements and questionnaire size for differing types of technology may vary greatly, and should be taken into account when designing the forms.

3.130   It is important that the data-capturing requirements of paper questionnaires not overly affect the respondent's perception of the questionnaire. When designing forms for more

advanced data-capturing methods, such as imaging, it is necessary to establish that the respondents are able to provide answers in a suitable format that can be recognized by the data-capturing equipment. If the forms are self-enumerated, this will require extensive testing, including processing of live data from tests.

3.131   Box 22 presents considerations to be taken into account when designing census questionnaires.

Box 22. Census questionnaire design

The type of questionnaire, its format and the exact wording and arrangement of the questions require most careful consideration, since the handicaps of a poorly designed questionnaire cannot be overcome during or after enumeration. Among the many factors that should be taken into account in designing the questionnaire are the method of enumeration, the type of questionnaire, the data to be collected, the most suitable form and arrangement of the questions, the technology used and the processing techniques to be employed.

Source: Principles and Recommendations for Population and Housing Censuses, Revision 3, para. 3.26.

3.3   *Interviewer or respondent perception of the questionnaire*

3.132   The layout and design of the questionnaire will have a direct impact on how interviewers or householders will complete the questionnaire and the accuracy of the data supplied. Therefore, special consideration should be given to graphic presentation, placement and presentation of instructions, the use of space, layout and colours, and the wording used.

3.133   Poor use of any questionnaire design element, be it language, question sequencing or layout, creates an obstacle for the respondent or interviewer. A poorly designed and tested questionnaire causes higher item non-response rates and lower data quality because of wrong replies.

3.4   *Specifications for electronic questionnaire*

3.134   If using an electronic questionnaire, the subject matter specialists who define the questions and responses should work closely with software programmers to design the questionnaire and the data capture programme. Subject matter specialists should develop the specifications or a set of instructions for writing the data capture program. The specifications should contain all information the programmers need to write the code for this application, including question and response wording, skip patterns, enumerator instructions, data validation, error messages and data structure. Chapter II, section C, contains further information on use of technology.

D.   Testing and evaluating census questions and procedures

3.135   The approach to testing will be greatly influenced by the size and diversity of the population, the enumeration method, the processing method and the resources available.

3.136   Recruiting, training and paying the staff necessary to carry out a test of the size necessary to produce worthwhile results is a major exercise, which will incur significant expenses. These expenses should be fully included in the total costing of the census. The importance of adequate testing to ensure successful census outcomes should not be underestimated.

1.   What should be tested

3.137   The testing programme should be comprehensive enough to test effectively all of the main components of the census. As well as testing the questionnaire, the testing programme should test any guide or other information booklet, enumeration procedures (including training and administration of temporary census staff), and processing procedures. Ideally, at some stage during the testing programme, each stage of the census would be tested, up to and including the delivery of output.

2.   Calendar of census tests

3.138   In general, early in the testing process, the tests will focus on questionnaire design issues and any of the collection procedures that warrant testing, such as enumeration area design, mapping and enumeration management. Later on in the testing programme, testing should include processing systems and procedures and dissemination systems.

3.139   Table 8 shows an example of a testing programme as a guide to the type and timing of tests that may be conducted in the lead-up to a census. The nature of the testing programme for each country will largely depend on the resources available. It will also depend on factors such as the extent of proposed changes to the questionnaire, procedures and processing systems.

Table 8

Census questionnaire testing programme

Purpose of test	Time to census date
Specific purpose test for proposed new question(s)	At least 3–5 years
Form design and enumeration procedures	At least 3–5 years
Specific purpose test for proposed new processing technology	At least 3–5 years
Specific purpose test for enumeration procedures in remote area	At least 2 years
Major test (or pretest) of final form design, enumeration and processing systems	At least 2 years
Dress rehearsal (or pilot test) of enumeration, processing and dissemination systems and procedures	At least 1 year

3. Principles of census testing

3.140 It is likely that the census questionnaire and procedures will undergo several changes as their performance is tested and issues are identified.

3.141 The principles of good census testing are to:

(a) Evaluate the performance of a questionnaire or procedure before changes are made;

(b) If necessary, change the questionnaire or procedure to improve its performance;

(c) Evaluate the questionnaire or procedure after changes are made to find out if its performance has improved.

4. Questionnaire testing

3.142 The main purpose of questionnaire testing is to ensure that the questionnaire has the following attributes.

(a) **Functional.** All aspects of the questionnaire (including the question texts, response options, missing values, branching, routing instructions, error messages and data transfer) work as specified under all possible situations.

(b) **Usable.** The enumerators can effectively and efficiently make use of the questionnaire to collect necessary data.

(c) **Accurate.** The questions are able to elicit accurate data.

(d) **Acceptable.** The questions will not trigger rejection from the respondent.

3.143 Many countries concentrate their testing programme on new topics or questions, but it is also important to test the impact that these new questions may have on other questions on the questionnaire.

3.144 Elements of questionnaire testing discussed here include question development, field testing, experimental comparisons, analysis of errors, and other analysis of testing data.

4.1 Question development

3.145 During the question development stage, the questions are tested in house before they are tested in the field. Testing methods used include interviewer focus groups, scoping interviews, respondent focus groups, cognitive interviews and expert review.

(a) Interviewer focus groups are used to identify any problems with existing census questions. The focus groups may consist of approximately 6–12 experienced interviewers with a moderator.

(b) Scoping interviews are conducted with researchers and experts for new topic areas to assess the feasibility of gathering data on the topic.

(c) Respondent focus groups usually occur before the questionnaire is constructed. They are moderated group discussions with approximately 6–12 participants who share their experiences and opinions about topics or wording of questions.

(d) Cognitive interviews are one-on-one interviews conducted by a specially trained cognitive interviewer to better understand the cognitive processes of the respondent when answering specific questions. These could also include the observation of respondents filling out the questionnaire to check for omissions and errors. These interviews are used to evaluate the questions and modify them appropriately as needed.

(e) Expert review is a review by experts, such as survey methodologists, to evaluate the questionnaire for potential problems it may present to interviewers and respondents.

4.2   Field testing

3.146   Field testing is the testing of the questionnaire using actual interviewers and respondents. Initially, field testing is done as a small-scale pretest. In a small-scale pretest, a few interviewers (about three or four) administer the questionnaire or a portion of the questionnaire to a small number of respondents in the same way that they would perform the task during the actual census. Once the questionnaire has been tested on a small scale, a large-scale pretest can be conducted to test the final form design, enumeration and processing systems.

3.147   Behaviour coding, interviewer debriefing and respondent debriefing should accompany field testing to facilitate the analysis of the results.

(a) Behaviour coding occurs when an observer listens to interviewer–respondent interaction and then assigns systematic codes to their behaviour. The codes can be quantified and their patterns analysed.

(b) Interviewer debriefing following the pretest involves the interviewers providing feedback on problems that they encountered during the pretest process.

(c) Respondent debriefing uses structured follow-up questions at the end of a field test interview to identify any problems the respondents had in interpreting the questions.

4.3   Experimental comparisons

3.148   The question development processes and field testing of the questions lead to identification of problems in the questionnaire and modification of the questionnaire to address them. However, it is not always clear whether the revisions are improvements to the original questionnaire. Experimental comparisons are helpful in determining whether improvements can be made by modifying the questionnaire. There are two main ways to approach the comparisons.

(a) **Comparison of test results.** One way is to conduct another round of tests after the questionnaire revision and compare the test results from old and new questions.

(b) **Split sample experiments.** Another method is to randomly divide a sample of respondents in half, then randomly assign each subsample to a different version of the questionnaire. This method can also be used to test survey procedures.

4.4   Analysis of errors

3.149   An analysis of errors consists of counting and tabulating the number and type of errors that have occurred on a sample of forms during field tests or from the previous census.

3.150   The purposes of an analysis of errors are the following:

(a) To find out what errors are occurring on a questionnaire;

(b) To provide a benchmark against which to judge the questionnaire's performance;

(c) To provide information on which to base modifications of the questionnaire that will lead to a reduction in errors;

(d) To determine the costs of repairing the errors, both before and after redesign.

3.151   An analysis of errors is the most important quantitative measure of a questionnaire's performance. It is the basic quantitative benchmark against which the performance of one questionnaire can be compared with that of another. It also provides an estimate of some of the less obvious costs, such as the repair of errors in the processing phase and respondent burden.

3.152   If errors remain unnoticed, they can seriously affect the quality of data. Good design can reduce the incidence of errors on forms. However, it is not possible to improve the design of a questionnaire if it is not known how the questionnaire has performed in the past. Therefore, an analysis of errors should always be conducted first before attempting to improve the design of a questionnaire. After the questionnaire has been improved another analysis of errors should be conducted. A comparison of the before and after results is the best evidence that the questionnaire has been improved.

3.153   There are many kinds of errors, and they have a variety of different causes for which different remedies are necessary. When conducting an analysis of errors, it is important to distinguish between the different kinds of errors. There are generally three basic types of errors: omission, commission and mistakes.

(a)   Omission

3.154   Errors of omission occur when respondents fail to answer a question. Respondents may fail to answer a question because they do not notice it, because they deliberately avoid it or because they do not understand it. These include refused and "don't know" responses.

3.155   Omissions are extremely hard to diagnose in an analysis of errors, partly because they can be due to many reasons. In addition, a blank answer space on a questionnaire may be perfectly legitimate and not particularly significant in itself. The reasons for these errors have to be analysed in conjunction with other procedures.

(b)   Commission

3.156   Errors of commission result when respondents give information they were not asked for. They can arise because of a misunderstanding of questions or incorrect assumptions. Commissions are easier to notice than omissions in an analysis of errors, but caution should be exercised in drawing conclusions without the support of results from other investigations. In most cases, unnecessary information is not as expensive to deal with as omissions or mistakes. Errors of commission often result from failure to follow routing instructions such as "go to part …". While the additional answers provided are not harmful in themselves, the increase in respondent effort and often frustration can have a serious effect on how accurately the remainder of the questionnaire is completed.

(c)   Mistakes

3.157   Mistakes result when respondents give incorrect information. There are many reasons why people make mistakes on forms, leading to problems in identifying the causes of this type of error. Moreover, not all mistakes are noticeable. For example, if the question on the questionnaire asks respondents to give their income and they give their net income when their gross income was needed, the mistake would go unnoticed unless there was an independent check. However, one of the great advantages of analysing mistakes is that many of them are directly observable and can provide clues to a questionnaire's performance. Other procedures, such as cognitive testing, can be used to determine the causes of mistakes.

4.5   Other analyses of testing data

3.158   In addition to errors, the pretest data should be analysed for response distribution. A frequency distribution for each question should be examined, as well as cross-tabulations to see if there are any irregularities.

3.159   Furthermore, the quality and level of detail provided should be analysed. This is particularly important for open-ended questions such as occupation. How the question is worded will affect the level of detail given by the respondent. Subsequently, the level of detail given by the respondent will influence how the response can be coded, with possible implications for the quality of the output from the census. Therefore, as part of the testing programme, these questions should be coded to the established classifications to ensure that the level of detail being reported is sufficient for coding purposes.

5.   Pilot census

3.160   The testing programme should include a pilot census (or dress rehearsal). This is the final test, at which the enumeration, processing and dissemination systems, and the interface between them, are tested to resolve any outstanding problems. The questionnaire design should be final (including the translations in other languages) at the time of the pilot census and should not be changed after the pilot, unless significant errors are identified. The pilot census needs to take place well in advance of the actual census enumeration (at least one year prior to the census) to allow for sufficient time to analyse the results and resolve any

problems identified during the pilot. In the case of censuses using handheld digital devices, the pilot should provide for a thorough testing of all applications and data transmission procedures (table 9).

3.161   The pilot also provides an opportunity to revise the costing estimates. In order to obtain accurate costing estimates from the pilot, the final questionnaire design needs to be available and all systems have to be tested for acceptance beforehand.

Table 9

Census testing

Questionnaire testing	Pilot census
• Small scale • Tests the suitability of: (a) the intended census questions, including their formulation and the instructions provided; (b) questionnaire design • Tests in general public and special population groups • Estimates time requirements in enumeration • Several rounds may be done	• Large scale • Tests the entire census infrastructure • Covers one or more sizeable administrative divisions • Tests preparatory, enumeration, and processing stages of a census • Best if conditions in the pilot census are close to the conditions present during the actual enumeration • Often conducted exactly one year before the planned census • Pilot census data do not produce usable substantive data, though analysis of errors from the data may be informative for identifying problems

E.   Instruction manual preparation

1.   Introduction

3.162   The present section includes suggested contents for the primary handbooks (or manuals) required for field operations. They are divided into three categories, representing the three levels of field staff used in the present handbook. These are:

(a) Enumerators;

(b) Supervisors;

(c) Regional managers and deputy regional managers.

3.163   Given the hierarchical nature of the census operation, the handbook for each level of staff should supplement the handbook for the level below it. Therefore, the enumerator's

handbook will contain detail appropriate to that level, whereas the supervisor's handbook assumes that the supervisor is familiar with the content of the enumerator's handbook. Detail in the supervisor's handbook provides additional information about enumerator duties but avoids repeating material already included in the enumerator's handbook. Therefore, while many headings will be the same between handbooks, the content under those headings will differ in each. The main exceptions would be the timetable and introductory parts, where some repetition is necessary or desirable.

3.164   All handbooks (and other manuals and materials) should aim for commonality, wherever possible. This includes consistency of layout, style and imagery (for example logos). The use of different colours for covers would provide easy distinction between topics.

2.   Enumerator's manual

3.165   The enumerator's manual is the most important field document, along with the enumerator's record book. It details the responsibilities and tasks of the enumerator and should provide sufficient information for an enumerator to work independently in the field. The enumerator's manual is often the only reference available in the field, and as such should include sufficient information to cover most eventualities. However, it should not attempt to cover every eventuality. This may lead to the manual being too bulky and give enumerators the impression that the job is more difficult than it really is. The aim should be to cover most ordinary situations in some detail and provide guidance on how to deal with unusual situations, should they occur.

3.166   The enumerator's manual should focus on issues related to census taking and avoid including information about administrative arrangements (such as recruitment and payment), which should be provided separately. The content of and the navigation through the manual would depend on whether the manual is in paper or electronic form. The electronic version provided on handheld digital devices allows for faster identification of topics and access to the text, as well as the provision of help information for queries and questions.

3.167   Topics, in particular process-type activities (such as filling in a form), should be covered in bullet (or dot) point form, wherever possible. This will assist in quick referencing, in particular when in the field.

3.168   The following is a potential set of topics to include in the enumerator's manual. If the interviewers will be using an electronic questionnaire, then each of the topics below should include special instructions on care and handling of the electronic device, such as laptops or tablet personal computers (PCs) (box 23).

Box 23. New technology in the census manual: 2010 census in Cabo Verde
The census enumerator's manual during the 2010 census in Cabo Verde had a section on the functionality and mode of operation of the personal digital assistant (PDA) in order to facilitate its use by the census enumerator and ensure that the information collected was properly stored and transmitted. The manual described the PDA's outer components, battery charging instructions, software installation procedures, and basic functioning operations. It also indicated the types of connections that could be established, as well as the procedures that could be followed when experiencing difficulties. In addition, the manual contained information on the procedures to initiate the PDA when working in the enumeration area, digital maps, electronic questionnaires, navigation procedures for the questionnaires, instructions on how to correct existing records, saving the collected information, backing up, and transmission of records to census headquarters.
Source: Instituto Nacional de Estatística, Cabo Verde.

2.1   *Timetable*

3.169   Having a timetable of census tasks and activities in the manual would provide easy referencing throughout the operation. A good place to insert the timetable is on the inside front cover (or first pages) of the manual.

2.2   *Background to the census*

3.170   The manual should have a section that describes the census, who takes it and why. It should introduce the goals and objectives of the census, emphasize the importance of the enumerator's role and describe the overall operational arrangements. Suggested sections include:

(a) Description of the census;

(b) Description of the census agency (or implementing agency);

(c) Census management and organization, including structure of the census workforce;

(d) General concepts on census quality.

2.3   *Enumerator roles and responsibilities*

3.171   The manual should outline clearly the responsibilities of the enumerator, materials handled by the enumerator, and correct conduct of the enumerator:

(a) Enumerator duties;

(b) Materials and equipment for the enumerator, including list of materials and equipment, handling of materials, care and management of equipment (such as for tablet PC if using electronic questionnaire), and procedures for lost materials or equipment or non-working equipment;

(c) Enumerator conduct, including dress code and census identification tag, codes of conduct, confidentiality, and safety;

(d) Training requirements, including training schedule and attendance requirements.

2.4   Basic concepts of the census enumeration

3.172   Defining the basic concepts of the census enumeration early in the manual ensures that all enumerators have the same understanding of the terminology. Examples of topics to explain in this section include:

(a) Enumeration unit;

(b) Census moment;

(c) Census population;

(d) Mapping and census geography (such as enumeration area or village);

(e) Establishment;

(f) Dwelling unit;

(g) Household;

(h) Usual residence.

2.5   Interviewing techniques

3.173   The manual should contain advice to the enumerators on how to conduct a good interview. Suggested sections include:

(a) Establishing rapport;

(b) Principles of interviewing;

(c) The art of asking questions;

(d) Sensitive topics;

(e) The best time of the day.

2.6   Tasks before the enumeration

3.174   This section contains procedures that should be conducted before the enumeration begins. Some topics to discuss in this section include:

(a) Receiving the materials;

(b) Receiving the enumeration area assignment;

(c) Using the map;

(d) Practical orientation to the enumeration area;

(e) Identifying the enumeration area boundaries;

(f) Testing of equipment (if using electronic questionnaire);

(g) Pre-listing procedures (if conducted).

2.7   Tasks during the enumeration

3.175   The enumeration procedures outline the steps the enumerators must take to conduct the census enumeration. Below are some topics to include in this section:

   (a) Time of day to conduct interview;

   (b) Procedures for making contact;

   (c) Procedures for such issues as refusals, no contact or vacant dwelling units;

   (d) Respondent criteria;

   (e) Interviewing procedures;

   (f) Closing the interview;

   (g) Sampling procedures if sampling is used;[51]

   (h) Completing the record book or control forms;

   (i) Language issues;

   (j) Transmission of and backing up data (if applicable, when using electronic questionnaire).

2.8   Special cases

3.176   This section describes any special enumeration procedures that should be followed. Some examples of such cases are:

   (a) Special (non-private) dwellings (such as hostels, hotels, prisons, military institutions and installations);

   (b) Special populations (such as transitory, seasonal or homeless populations);

   (c) Special strategies (for example, for remote or isolated areas, inner city areas, or large holiday resorts).

2.9   Tasks after the enumeration

3.177   The present section sets out the tasks to be carried out immediately after the enumeration is completed. It focuses on quality-related issues and ensuring that all questionnaires are accounted for and that enumerator checking is complete. Suggested sections are:

   (a) Sorting and checking questionnaires;

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[51] If the census uses the short- or long-form paradigm, then the sampling will always be a necessary part of the enumeration procedure. Therefore, the instructions on which households should be interviewed using the long form needs to be part of the package. In a number of censuses, that would be every fifth or every tenth household, resulting in a 20 per cent or 10 per cent sample.

(b) Checking all dwellings and housing units on the map, and in the census record book or control forms;

(c) Completing summary records;

(d) Data transfer from laptop or tablet PC (if using electronic questionnaire);

(e) Packing questionnaires and materials;

(f) Returning materials to supervisor;

(g) Certifying work completed;

(h) Administrative procedures.

2.10 Explanation of the questionnaire

3.178   This section should include the description of each question and any special instructions or advice for each question. Suggested sections are as follows:

(a) Introduction to the household questionnaire;

(b) Introduction to the individual questionnaire;

(c) General instructions on how to fill out the questionnaire;

(d) Question-by-question description of the questionnaire.

2.11 Annexes

3.179   There may be some topics that are better covered as a separate annex rather than within the body of the manual. These are often matters that are useful to the enumerators as a reference during the enumeration process, but are not covered in the training. Annexes may include the following:

(a) Definitions or glossary;

(b) Frequently asked questions;

(c) Additional mapping information;

(d) Equipment operation and troubleshooting guide (if using electronic questionnaire);

(e) Historical calendar of events for estimating date of birth or death.

3.   Supervisor's manual

3.180   The supervisor's manual contains information for the supervisors to do their job. The supervisors should not only study the supervisor's manual, but should also be familiar with the enumerator's manual. The supervisor's manual should expand on the topics covered in the enumerator's manual without duplicating the material.

3.1   Timetable

3.181   The timetable is similar to the one included in the enumerator's manual, but may also cover additional tasks and activities required by the supervisors.

3.2   Background to the census

3.182   As in the enumerator's manual, the supervisor's manual should have a section that describes the census, who takes it and why. It should introduce the goals and objectives of the census, emphasize the importance of the enumerator's and supervisor's roles, and describe the overall operational arrangements. It may also have additional details or information that would help the supervisors to better understand their role in a quality census.

3.183   Suggested sections include:

(a) Description of the census;

(b) Description of the census agency (or implementing agency);

(c) Census management and organization, including structure of the census workforce.

3.3   Supervisor roles and responsibilities

3.184   This section outlines the responsibilities of the supervisors. As well as being responsible for the supervision and the quality of work of their enumerators, supervisors will often have additional responsibilities of an administrative or clerical nature. For example, where the enumerator's manual may describe safety in relation to working as an enumerator, the supervisor's manual will also need to provide details about what the supervisor should do if an enumerator reports a safety problem. Some suggested sections are:

(a) Supervisor duties, including assigning tasks to the enumerators, supervising and communicating with the enumerators, communicating with regional management, communicating with community leaders in the enumeration areas, census publicity tasks, quality assurance tasks, payroll, performance management, and ensuring safety of the enumeration team and incident reporting;

(b) Supervisor conduct, including dress code and census identification tag, codes of conduct, confidentiality and safety;

(c) Training requirements, including training schedule and attendance requirements.

3.4   Administration and recruitment

3.185   If supervisors are involved in the recruitment or payment of enumerators, a section on administration and recruitment will be required. Suggested sections are the following:

(a) Recruiting enumerators;

(b) Administration;

(c) Financial matters and expenses;

(d) Enumerator pay issues.

3.5   Training enumerators

3.186   If the supervisors are required to train the enumerators, the supervisor's manual should focus on how to conduct effective trainings. Suggested sections are:

(a) Preparation;

(b) Conducting the training;

(c) On-the-job training;

(d) Additional training.

3.6   Management of materials and equipment

3.187   Supervisors are generally responsible for coordinating the receipt and distribution of materials and equipment in their supervisory areas. This is a critical responsibility since the materials and equipment are fundamental to the census operation and contain confidential data after the enumeration has been completed. This section should outline the procedures involved in management of the materials and equipment:

(a) List of materials and equipment for supervisorial area;

(b) Handling of materials;

(c) Testing of equipment (if using electronic questionnaire);

(d) Care and management of equipment (such as for tablet PC if using electronic questionnaire);

(e) Procedures for lost materials or equipment or non-working equipment.

3.7   Tasks before the enumeration

3.188   This section contains procedures that should be conducted before the enumeration begins. Some topics to discuss in this section include:

(a) Setting up a field office to store census materials and equipment securely (if applicable);

(b) Receiving the materials;

(c) Distributing the materials to the enumerators;

(d) Receiving the supervisory area assignment and reviewing the workload;

(e) Reviewing or updating maps or boundaries;

(f) Practical orientation to the supervisory area;

(g) Assigning the enumeration areas to the enumerators;

(h) Creating an enumeration schedule;

(i) Pre-listing procedures (if conducted).

3.8   *Tasks during the enumeration*

3.189   This section should describe the supervisor's role during the enumeration. Special attention should be paid to aspects of the work that improve the quality of the data collected. Some suggested sections are:

(a) Supervising and observing enumerators during the interview;

(b) Reviewing the enumerators' record books or control forms;

(c) Ensuring that no area or dwelling is left out in the enumeration area by the enumerator;

(d) Ensuring that no area or dwelling is left between the boundaries of enumeration areas;

(e) Keeping track of enumeration progress;

(f) Reporting to regional management;

(g) Handling such matters as difficult cases, objections, refusals, no contact, or vacant dwelling units;

(h) Management and organization of materials;

(i) Checking the questionnaires;

(j) Transmission and backup of data from the enumerators (if using electronic questionnaire);

(k) Special dwelling issues;

(l) Other special cases;

(m) Language issues and providing interpretation;

(n) Redeployment of enumerators (for example, when they complete assigned tasks early).

3.9   *Tasks after the enumeration*

3.190   This section covers the supervisor's tasks immediately after the enumeration. It should assist supervisors in ensuring that all forms are accounted for and correctly completed and that the questionnaires are ready for processing. Suggested sections include the following:

(a) Checking and editing the questionnaires;

(b) Receipt of materials and equipment from enumerators;

(c) Accounting for materials and equipment returned from the enumerators;

(d) Making sure that completed questionnaires are sorted;

(e) Sorting and organizing unused material;

(f) Certifying enumerators' work;

(g) Completing summary records;

(h) Checking with enumerators that all dwellings, housing units on the map, and census record books or control forms are accounted for;

(i) Completing the supervisor's report;

(j) Making sure that all data from the enumerators' electronic equipment are transmitted or backed up (if using electronic questionnaire);

(k) Packing materials and equipment for return;

(l) Material delivery and pickup arrangements;

(m) Completing administrative tasks;

(n) Closing field office (if applicable).

3.10 Annexes

3.191　As in the enumerator's manual, there may be some topics or matters that are best covered as a separate annex rather than within the body of the manual. Annexes for the supervisor's manual may include:

(a) Frequently asked questions;

(b) Special enumeration strategies;

(c) Additional administration and recruitment information.

4. Regional manager's/deputy regional manager's manual

3.192　The nature and role of the regional manager (and the deputy regional manager, if included in the field workforce) may vary significantly from country to country. Included here is a suggested list of contents for a regional manager's manual. It assumes the regional manager:

(a) Will have access to a computer;

(b) Has a significant role in the recruitment and payment of staff;

(c) Has responsibility for financial delegation;

(d) Will have some involvement in public relations;

(e) Will conduct the training of the supervisors;

(f) Is fully familiar with the enumerator's and supervisor's manuals.

4.1 Timetable

3.193　The timetable is similar to the one included in the supervisor's and enumerator's manuals, but may cover additional tasks and activities required of the regional managers.

4.2   Background to the census

3.194   This section is similar to the section included in the enumerator's and supervisor's manuals. Further details can be added for the regional manager's manual to enhance the understanding of census operations at the regional level. Suggested sections include:

(a) Description of the census;

(b) Description of the census agency (or implementing agency);

(c) Census management and organization, including structure of the census workforce.

4.3   Regional manager roles and responsibilities

3.195   This section explains the roles and responsibilities of the regional manager. Some topics to include are:

(a) Census management and supervision, including communicating with supervisors, contact with the census agency or the national implementing body, distribution and collection of materials and equipment, ensuring the security and confidentiality of census materials and equipment, ensuring the safety of the enumeration team and incident reporting, code of conduct of regional managers and field staff, and performance and cost management;

(b) Publicity and communication, including establishing a census committee at the regional level, census publicity tasks, and communicating with community leaders, media, and key stakeholders at the regional level;

(c) Expenditure of government funds, including authority and role, general conditions and limits in purchasing, operating bank, trust, and credit card accounts, and acquittal and accountability.

4.4   Personnel recruitment and administration

3.196   If the regional manager is responsible for recruiting and managing the field staff, the manual should include a section that details the responsibilities of the regional manager in personnel recruitment and administration. Topics to be discussed in this section include:

(a) Recruiting and appointing supervisors, enumerators and other field staff;

(b) Recruitment policies and guidelines;

(c) Record keeping and employment forms;

(d) Payment rates, policies, forms and methods;

(e) Accident or incident reporting;

(f) Handling personnel issues (such as unsatisfactory staff, changes in staff after recruitment);

(g) Travel required for census work.

4.5   Training

3.197   If the regional manager will conduct the supervisor and enumerator training, the manual should contain a section on how to conduct the trainings. It is necessary that the content of the supervisor and enumerator trainings be established at the national level and that regional managers work with national level staff to ensure that the trainings are delivered consistently across all regions of the country. Items to be covered in this section include:

(a) Regional manager training requirements;

(b) Supervisor and enumerator training requirements and preparation;

(c) Advice for conducting trainings.

4.6   Census telephone services

3.198   If census telephone services will be provided, the regional manager's manual should contain information about such services. This section may include:

(a) Description of the operation;

(b) Regional manager's role;

(c) Supervisor's role;

(d) Enumerator's role;

(e) Administration.

4.7   Managing materials and equipment

3.199   This section details the management of materials and equipment at the regional level. Suggested topics to address in this section include:

(a) Regional manager's role in managing materials and equipment;

(b) Accountability for materials and equipment;

(c) Record keeping and forms for managing materials and equipment;

(d) Secure transport arrangements and contracts;

(e) Timetable of materials and equipment transport activities;

(f) Safe storage requirements for materials and equipment at the regional office and in the field.

4.8   Special enumeration strategies

3.200   This section should describe any special enumeration strategies that may be included in the overall census plan. It should also include the regional manager's responsibility in informing the central census office regarding any special enumeration strategies to be employed.

4.9　Tasks before the enumeration

3.201　As with the enumerators and supervisors, the regional managers will have a set of tasks to be completed before the enumeration. These should be listed in the manual and include:

(a) Reviewing and updating maps or boundaries;

(b) Reviewing supervisor and enumerator workloads;

(c) Identifying population groups and areas requiring special enumeration strategies;

(d) Creating an enumeration schedule for the region;

(e) Setting up a regional office to store census materials and equipment (if applicable);

(f) Checking data transfer system and procedures (if using electronic questionnaire);

(g) Receiving materials and equipment from the central census office;

(h) Distributing materials and equipment to supervisors;

(i) Pre-listing procedures (if conducted).

4.10　Tasks during the enumeration

3.202　The tasks of the regional manager during the enumeration should be clearly specified. These include:

(a) Daily communication with the supervisors to check progress;

(b) Analysing progress of the enumeration and projecting completion date;

(c) Reporting to central census office;

(d) Management and organization of materials at the regional level;

(e) Assisting the supervisors in handling such issues as difficult cases, objections, refusals, no contact or vacant dwelling units;

(f) Inviting public complaints regarding non-coverage during enumeration;

(g) Ensuring no area or dwelling is left out;

(h) Transmission and backup of data from the supervisors (if using electronic questionnaire);

(i) Analysing data quality from the data collected (if using electronic questionnaire and data are available for analysis);

(j) Special dwelling issues;

(k) Other special cases;

(l) Language issues and providing interpretation.

3.203   Some examples of the regional manager's tasks after the enumeration to be included in the manual are:

(a) Collecting materials and equipment from supervisors;

(b) Accounting for materials and equipment returned from the field;

(c) Making sure that completed questionnaires are sorted;

(d) Sorting and organizing unused material;

(e) Completing summary records;

(f) Certifying the supervisor's report and work completed;

(g) Completing the regional manager's report;

(h) Regional manager's role in transmitting and backing up data (if using electronic questionnaire);

(i) Packing materials and equipment;

(j) Delivery of materials and equipment to the central census office;

(k) Analysing data quality from the data collected (if using electronic questionnaire and data are available for analysis);

(l) Completing administrative tasks;

(m) Closing the field office (if applicable).

F.   Recruitment and payment

1.   Introduction

3.204   In some countries, thousands of staff members, spread over wide and varying geographical areas, are required for field operations. The majority of these staff are only required for the relatively short enumeration period (usually around three weeks). In some countries, they may be recruited from the general public. In others, existing staff from other government ministries (such as teachers) may be used.

3.205   The principal objectives of the recruitment exercise should be to recruit staff who are capable of undertaking the duties of the various positions and in sufficient numbers for all geographical areas.

3.206   The quality of the recruitment campaign will directly affect the quality of the data to be collected, and therefore the success of the census. While a good recruitment campaign may not by itself guarantee a successful census, a badly conducted recruitment campaign will inevitably lead to problems and increase the risk of an unsuccessful census.

3.207   Payment to field staff has a direct effect on the recruitment campaign. Pay rates should be fair and equitable in comparison with market rates for broadly similar tasks in other

jobs and commensurate with the amount and difficulty of the work in order to attract and retain quality staff. In countries where existing staff from other government ministries are used, they are generally paid per diem costs. Again, these payments must be fair and equitable to allow the staff to perform their duties to the best of their abilities.

2.   Recruitment

3.208   By the time the recruitment campaign is considered, the structure and ratio of staff in the various levels of the field operations hierarchy will have been established (see chap. II, sect. D.4, on structure of the workforce). The other major factor affecting the recruitment campaign is the basis of the enumeration. This has been discussed in chapter II, section B.3, on establishing the basis of enumeration.

2.1   *Determining the number of field staff*

3.209   The first step in the recruitment campaign is to determine the number of field staff required. This can be done by adopting a bottom-up approach. This means starting at the lowest geographical level, such as an enumeration area. One enumerator usually canvasses an enumeration area. The first step would therefore be to determine the number of enumeration areas and establish the number of staff required. Workload statistics can then be applied to derive the number of supervisors required. This can then be repeated for all levels in the management hierarchy.

3.210   A different approach will certainly be necessary depending on the method used for enumeration. In the case of combining personal interviews with Internet collection, the number of field staff will then depend on the assessment of the population that will provide replies online. This computation will be based on the experiences of the previous census and the pilot census.

(a)   Number of enumerators

3.211   The number of enumerators required will also depend on the length of the enumeration period. The shorter the enumeration period, the more the enumerators required. Generally, an enumeration area is defined as the geographical area covered by one census taker. Initial estimates (for example, those required for developing an initial budget) can be based on the number of enumeration areas in the previous census, adjusted by the rate of population growth. These initial estimates can be updated as the enumeration area design and mapping or household listing processes evolve.

3.212   Having one enumerator per enumeration area is possible if the area is designed to meet a standard degree of effort or workload. The standard workload for an enumerator is expressed as the expected number of households to be completed in a given number of days with an expected number of hours worked per day. It may be based on some or all of the following:

   (a) An existing standard in the country;

(b) The duration of the enumeration period;

(c) The average time it takes to complete a household;

(d) A realistic assessment of staff availability by day over the duration of enumeration, considering such factors as travel time to and from the area, hours of daylight, the standard working day, expected limitations on enumerator availability (for example, whether the average enumerator will only be available on a part-time basis owing to other employment), and some margin for contingencies, considering abnormal circumstances.

3.213   To test each enumeration area against this standard, the following issues may need to be considered:

(a) Total number of households in the enumeration area;

(b) Time estimated per household;

(c) Characteristics that may make enumeration more difficult, including low population density, remote areas and difficult terrain. This criterion may be best expressed as a weighting, according to which time per household is increased or decreased.

3.214   Ideally, the standard is applied to each enumeration area during the design process well before enumeration.

3.215   The number of enumerators required may need to be adjusted for various reasons. These include:

(a) When the population size of the enumeration area has changed drastically from the previous census;

(b) Some population groups may require particular attention from specialist enumerators (for example, enumerators who speak a particular language);

(c) A separate enumerator may be required for special dwellings in enumeration areas, such as hospitals, hotels, defence force barracks or prisons.

(b)   Numbers of supervisors, regional managers and deputy regional managers

3.216   After the number of enumerators has been established, it is possible to work up the hierarchy, level by level, to establish the numbers of supervisors and managers. The ratio of enumerators to supervisors has already been discussed in chapter II, section D.4, on structure of the workforce.

3.217   The principles used to determine the required number of these positions are the same for all of the supervisory and management levels. To begin with, a standard based on the number of employees to be supervised or managed must be decided. This standard will depend on the following:

(a) Any existing standard and previous census and survey experience;

(b) The amount of face-to-face time required with subordinates;

(c) Travel time, which itself is often correlated with the size of the area of responsibility;

(d) Estimated time required to be spent on tasks not related to staff supervision and management;

(e) Amount of time available to undertake this work.

3.218   It is preferable that this benchmark be decided by the census agency and adapted in the field (with advice from the census agency where necessary), where local circumstances such as the following exist:

(a) The population density of the area may increase the distance that needs to be travelled;

(b) The characteristics of the area may make enumeration more difficult and therefore require a greater level of managerial or supervisory support of enumeration staff.

(c)   Number of reserve staff

3.219   Experience has shown that staff at any level in the field workforce may not complete their duties during the conduct of enumeration owing to a variety of reasons. These could include the following:

(a) Availability of better employment;

(b) Sickness;

(c) Staff dissatisfaction with the duties that they are undertaking;

(d) The census agency terminating their employment owing to poor performance.

3.220   In addition, if there is a long lag time between the recruitment campaign and the actual enumeration period, some staff may not begin their duties because they have found alternative employment or have lost interest in the job.

3.221   In these situations, it is necessary to consider, and be ready to implement, strategies on how the workload can be completed without reducing quality standards. Whatever strategy is adopted, it must be able to be implemented quickly and efficiently. Strategies that may be considered are the following:

(a) Utilizing a pool of reserve staff that have already been trained;

(b) The workload being taken over by other workers of the same level who have completed their workload or are able to accept further demands;

(c) The workload being taken over by other workers at a higher level;

(d) Promoting staff to a higher level (for example, promoting an enumerator to a supervisor's position).

3.222   The appointment of a suitable number of trained reserves is a key strategy that will reduce delays in the critical time of enumeration. The enumeration period is short and reserves need to be available, and able to be placed, in the field in a short period.

3.223   Reserves could attend the same training session as the staff that they may replace. The appointment of reserves will involve extra payment, since they will usually be paid a retainer of some type, regardless of whether they undertake any actual work. The number of such staff needs to be decided in terms of cost and the work done to date. However, an important message is that reserves will be needed to cater to the inevitable shortfalls that will occur in the field.

3.224   In larger geographical areas, the appointment of more reserves will reduce the possibility of one reserve having to undertake a large amount of travel (for example, from their home to the area where assistance is required).

3.225   An open and informative recruitment process is regarded as the key to reducing the frequency of resignations by census field staff owing to job dissatisfaction. It is essential to provide applicants for census positions with accurate statements of the duties to be undertaken, amount of workload, compensation and quality expectations.

2.2   Recruitment campaign

3.226   In general, the vast majority of positions in field operations will be filled by members of the public who are recruited through a recruitment campaign. However, some positions may be filled by people from special groups (such as schoolteachers or heads of villages) through direct appointment.

3.227   There are four important issues to consider with respect to the recruitment campaign: (a) the timetable; (b) the type of campaign; (c) publicity; and (d) government regulations.

(a)   Timetable

3.228   As noted above, an important issue when recruiting staff is to recruit them as close as possible to the date when they will begin work. However, recruitment cannot begin too late, as this may leave insufficient time to undertake additional recruitment campaigns in areas where there may be a shortfall in applicants.

3.229   The recruitment campaign can be conducted separately or concurrently for each level of staff. However, selection within field operations normally works on a cascade principle, that is, where each level in the field staff hierarchy is responsible for recruiting the next level down. Issues to be considered include the following:

(a) Employment commencement dates, which may differ for each level of staff;

(b) Capacity required to process a large number of applications at one time rather than processing smaller groups of applications over a period of time;

(c) Adoption of a joint process, which can be universal or only apply to various components of the recruitment campaign, such as advertising, distribution and processing of applications (a joint process often leads to efficiency savings);

(d) Desirability of attracting applicants of appropriate quality to each level in the management hierarchy. If joint advertising is used for all levels, a greater proportion of applicants are likely to apply for every position.

(b) Type of campaign

3.230   Government agencies may have established networks of both permanent and temporary workers who could be approached to support the census. In some countries, it may be possible to use existing social, as opposed to employment, networks to attract prospective employees.

3.231   These staff may be possible applicants for field operations positions, in which case advertising should be placed in the relevant media or key members of the network approached for assistance.

3.232   If government staff are not available for census duties, they may be able to assist by including census advertising in any internal media, such as newsletters and staff bulletins. This may attract current staff that are able to undertake census duties when they are off duty from their usual positions. Other government agencies, such as post offices, electoral offices and local government bodies, may also be prepared to display and distribute recruitment materials (such as posters and pamphlets).

3.233   In the early stages of planning the recruitment campaign, the census agency will need to identify which government agencies can be of assistance. A proactive approach can then be made to these agencies to obtain their support for census activities.

3.234   Community groups or institutions provide an opportunity to disseminate the recruitment campaign among groups that do not normally access the mainstream media. Posters and information about field positions can be distributed to such places as community centres, libraries, universities, schools, neighbourhood groups and sporting clubs. The use of community groups can be particularly effective in remote areas. New media outlets, especially Facebook and Twitter, can also be used to publicize the recruitment campaign.

(c) Publicity

3.235   Publicity is necessary for the recruitment campaign. Section C in the present chapter outlines publicity elements that can be adopted.

3.236   An important point is that the publicity should be organized and targeted towards potential applicants. Assumptions need to be made about the type of people that will comprise the majority of applicants, for example, unemployed persons, university students or homemakers. This will dictate which media are used and the methods of publicity.

3.237   There may be some regions in the country where there will be a possible shortage of applicants. These may be identified through previous experience in organizing statistical collections in such areas or based on local knowledge. Additional publicity should be organized as part of the initial campaign in these regions. It is important that publicity be dealt with proactively, as time is crucial in this part of the census cycle. Remote areas may

fall into this category and special attention should be given to utilizing community networks that exist in those areas.

(d)   Government regulations

3.238   In some countries government regulations may prescribe the methods that may be used for the recruitment of staff, and these will need to be taken into account. These regulations may not have been designed to handle the recruitment of large numbers of staff needed for the enumeration activity. In such cases, the census agency should negotiate with the appropriate government agencies to gain approval for more efficient hiring practices.

2.3   Selecting staff

3.239   The selection methodology should allow for large numbers of staff to be selected efficiently and enable the best-quality staff to be recruited from those available. In some areas, there may be an excess of applicants when compared with the number of available positions. A methodology to select the best staff can comprise the following:

    (a) Using standard application forms;

    (b) Distributing selection criteria and other information about the positions to applicants;

    (c) Assessing the applications and shortlisting, if required;

    (d) Conducting interviews, administering examinations or both.

(a)   Standard application forms

3.240   Using standard application forms, which all applicants must use, makes the task of comparing the applicants easier and more efficient. If designed in a way that is accessible to all, standard forms can also make the application process fairer.

(b)   Selection criteria

3.241   The selection criteria should list the most significant qualities, attributes or experience that an applicant should possess to undertake the position. These criteria will vary significantly among countries, and each country should develop them on the basis of its own particular circumstances. For example, if using mobile devices in data collection, one of the selection criteria may be familiarity with mobile devices. It is critical that the selection criteria be documented so that prospective applicants know the criteria against which they are to be evaluated.

3.242   Other information about each position can also be made available to the applicants. Some examples of information that can be provided include the following:

    (a) Type of work;

    (b) Duties of the position;

    (c) Dates showing the period of employment;

    (d) Days and hours of employment;

(e) Amount of payment, per diem rates and expected payment dates;

(f) Code of conduct expected of staff;

(g) Work conditions to be expected;

(h) Experience with technological tools pertinent to the data collection process (such as tablets or smartphones).

(c)   Assessment and interviews

3.243   The selection criteria may be used to assess the applicants in a systematic way to remove unsuitable applicants and to rank the remainder of the applicants in order of suitability. This can be done by scoring each applicant against each of the selection criteria. Any written references from previous employees can also be taken into account when assessing applications.

3.244   Those applicants who are regarded as suitable can then be interviewed to confirm their suitability for the position. A standard set of questions should be developed and asked of each applicant. Again, each applicant's performance at the interview can be scored.

3.   Payment

3.245   Field staff needs to be assured that payment will be commensurate with the amount and difficulty of the work they will undertake. The payment schedule also needs to fulfil their expectations and requirements.[52]

3.246   If these conditions are met, it is expected that field staff will not be distracted from performing their work by concerns regarding payment. The converse also applies. If field staff feel unhappy about their pay, especially in contrast with the conditions of employment offered prior to appointment, they will not produce high-quality work, with serious implications for the outcome of the census. Senior staff will also be distracted from quality work, with further serious adverse impacts on the quality of output.

3.247   An efficient payment system will only require a minimum of information flowing from the enumeration activity. This will lessen the administrative load on the supervisory and managerial positions.

3.248   The rates of payment and the schedule of payments must be finalized before recruitment commences, as applicants will require this information.

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[52] It is also critical to elaborate in full the implications of census work payment for an individual's income tax. The 2010 round of censuses documented, in certain circumstances, that the lack of such instructions had adverse impacts on the dedication of field enumerators, as they were expecting that income from census work was not taxable, which was not the case.

3.1 Developing a payment system

3.249 Development of a payment system includes determining the basis of payment, the payment timetable and the system design.

3.2 Basis of payment

3.250 There are numerous methods for establishing the basis of payment. In general, it should be simple and efficient to administer, be clear and understandable to staff, meet public expectations for work of this nature, be precisely documented, and allow for variation and flexibility according to the difficulty of the workload. It is also critical to honour the payments strictly according to the contractual provisions, and to develop contingency planning related to the disbursement of payments.

3.251 Payments can be based on a record of hours worked, an estimate of time per household or an estimate of time for the entire workload.

3.252 There are advantages and disadvantages for each option, as detailed in table 10.

Table 10

Basis of payment options

Option	Basis of payment	General application	Advantages	Disadvantages
A	Record of hours worked	For staff under direct supervision; this is not generally the case with field operations staff	Payment is only made for actual hours worked	High supervision overhead
B	Estimate of time per household	For staff where the amount of work in the workload is not known until after the contract is completed	Payment is made for every household enumerated The budget can be calculated on the basis of the number of units, together with growth factors	Staff cannot be advised of the total payment before completion of the contract Requires a greater degree of administrative effort to process, which delays the date of final payment Enumerators may be tempted to increase the number of households in their workload
C	Estimate of time per workload	For staff where the amount of work in the	Staff can be advised of the payment before	Relies on estimate of workload size being reasonably accurate

Option	Basis of payment	General application	Advantages	Disadvantages
		workload can be estimated	commencement of contract Administratively simple: requires little information flow from collection process Ensures timely payment	Enumerators may not revisit households where they were not able to get contact during the initial visit
D	Fixed payment	Usually in countries that use staff from other government ministries	Same as option C above	Provides no incentives to staff to complete the workload
E	Fixed payment, plus additional rate based on the number of households above a certain level	Usually in countries where the amount of work cannot be easily estimated	More homogeneity in the payment of enumerators	Staff cannot be advised of the total payment before completion of the contract Requires a greater degree of administrative effort to process, which delays the date of final payment Enumerators may be tempted to increase the number of households in their workload

3.253   Option A is not the best match for enumerators because of the high supervision overhead associated with it and the widely dispersed nature of field operations. Both options B and C are feasible, or a combination of both is possible. While options B and C require a commitment by staff to a contracted amount, there will be occasions where staff are required or directed to work over and above normal expectations. As a result, the pay system needs to be flexible enough to accommodate such cases. Staff will also need to be flexible enough to recognize that their employment contract is based on an average.

3.254   The degree of certainty in option C, for both the employee and the census agency, has considerable benefits. However, for areas of significant change in workload size, the physical amount of work may be so variable as to make this approach unworkable.

3.255   Regional managers (and deputy regional managers) can be paid on the basis of the number of staff under their control, with weighting for areas of geographical or social complexity. Given that workloads have been designed on this basis, it is highly likely that there will be little variance in payment amounts.

3.3   *Payment timetable*

3.256   The payment timetable needs to balance the needs of field staff against the cost of processing payments. Each individual payment has an associated cost, and therefore the more frequent the payments the higher the cost to the census agency. Depending on the nature of the payment processing system, these costs could be significant.

3.257   The timetable will also be determined by the availability of both personnel and payment data necessary to process payments. Personnel data are an output of the recruitment activity and payment data an output of the enumeration activity. Sufficient time should be allowed for the collection, processing and checking of the data.

3.258   In general, total payment should not be made in advance of work performed. If this occurs, staff lose the financial incentive to complete their workload and staff that do not complete their contract may be overpaid. However, in some countries, a small advance payment is made to cover any costs that the field staff may incur while undertaking their duties (such as travel expenses).

3.259   In some countries, multiple payments are made throughout the enumeration period. In these cases, the payment timetable should be based on conservative estimates of the rate of workload completion, by date, for each level of staff.

3.260   The timetable needs to be realistic, as it must be guaranteed as deliverable. A late payment will generate hardship for staff that have made personal financial commitments based on their expectations from the payment timetable. It will also impose an extra and unnecessary workload on the census agency because of the many enquiries from staff trying to ascertain when they will be paid. These enquiries can become a major burden on the agency when all attention should be devoted to ensuring the quality of the work being undertaken. If such a situation arises, it is to be expected that the work of the field operations staff will suffer, thus diminishing data quality.

3.4   *System design*

3.261   Once the basis of payment and the payment timetable have been established, a system to make the payments can be considered. The system can be clerically based, electronic or a combination of both. Factors to consider include the following:

    (a) Present systems in place in the census agency;

    (b) Delegation of administrative control of payment;

    (c) Security;

    (d) Accountability;

    (e) Reporting;

    (f) Government policy on outsourcing;

    (g) Links to other agencies.

3.262   Existing systems in the census agency may be used to pay field staff. However, there will be a significant increase in staff that must be paid during the enumeration period. Therefore, the capacity of existing systems and their ability to handle the increase will need careful testing. Extra resources may need to be allocated to these systems to ensure that they can handle the expected load.

3.263   The administrative control of payments to staff may be delegated to different levels in the census agency. For example, this delegation may be organized centrally within the census agency or through any regional offices that may exist. Alternatively, this delegation may be given to different levels of staff in the field hierarchy (for example, regional managers).

3.264   Consider these two aspects of payment security:

(a) The need for the census agency to ensure that the systems employed are not susceptible to fraud;

(b) The need to ensure that funds are accurately transferred to the employees concerned.

3.265   Both of these matters will be greatly influenced by the infrastructure and administrative systems applicable within a country. It is therefore not possible to be prescriptive about the ways in which these broad principles are implemented.

3.266   Internal controls and audit trails should also be built into the system to ensure accountability. These can assist in minimizing overpayments and ensuring that funds are not misappropriated. However, there needs to be a balance regarding accountability. Risks should be weighed against costs. Too many edits and controls will slow down the system.

3.267   The system should be capable of producing standard management reports. These may include:

(a) Reports of expenditure by pay, which may be measured against the budget;

(b) Future estimated expenditure according to the payment timetable;

(c) Other internal reports, which may include staff numbers and average payments by level.

3.268   In many agencies, there may be a lack of expertise or infrastructure necessary to establish a payment system. Consideration should then be given to outsourcing the system.

3.269   However, outsourcing should be approached with caution. It is likely that few external providers of such services will have systems established to deal with the large number of employees to be recruited, paid and released within a very short period. It is likely that the external supplier will have to undertake the same system development exercise as the census agency, but without the ownership of the process held by the census agency. This ownership recognizes the direct link between payment and quality of statistics.

3.270   The system may also be required to have links to other agencies. For example, these may be required in countries with personal income taxation arrangements. In these cases,

discussions should be held with these agencies to ensure that the necessary links are established and tested well before the enumeration period.

3.271   As with all census systems, the payment system should be subject to rigorous volume testing before it is implemented into field operations.

3.272   Box 24 gives an example of challenges that may be faced in putting in place an appropriate payment system for census field staff.

Box 24. Payment system challenge: 2011 census in South Africa

Ensuring the timely payment of field staff is a true test of the success of any census undertaking. The payment system for the 2011 census in South Africa was outsourced using a prepaid ATM card for all employed contract workers eligible to receive stipends. Over 160,000 trained fieldworkers were issued with a cash card, which was to be used for payment once the employment contract was concluded. The process of payments was however less than smooth, owing to underestimation of the volume of transactions and the logistics required for their disbursement. This was exacerbated by the limited ability of some individuals to use ATMs, resulting in payment delays, queries and disputes. A valuable lesson learned was to avoid making assumptions about the general population's exposure to technology, in this case access to such services as automatic teller banking.

Source: Statistics South Africa.

G.   Field staff training

1.   Introduction

3.273   A high proportion of staff from all levels of the field workforce are usually short-term temporary staff. They generally have limited experience or training in statistical collection activities. It is therefore important that they be given sufficient training to understand the following matters:[53]

    (a) The importance of their duties;

    (b) How their efforts fit into overall census goals;

    (c) Issues such as confidentiality;

    (d) The way they are expected to undertake their duties.

3.274   Providing sufficient training to these staff at the beginning of their relationship with the census is a good step towards enabling them to undertake their duties in an efficient and

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[53] Examples of field staff training, including the length of training, for the countries in the Economic Commission for Europe (ECE) region in the 2010 round of population and housing censuses are available in *Measuring Population and Housing: Practices of ECE Countries in the 2010 Round of Censuses*, Economic Commission for Europe, Geneva, 2014, table 4.4.

positive manner. This is a significant step towards achieving a high level of quality in the overall census outcome.

3.275   A further benefit of good training is that it will achieve a positive relationship between the field staff and the census agency. This is potentially of great benefit if it increases the proportion of the staff who come forward to undertake census duties in the future. While these staff will still require training, it will be more a case of refreshment of knowledge or skill enhancement than of basic skill provision. This will improve the quality of the census through a more cost-efficient operation and a higher level of accuracy in work.

3.276   In countries that use a short-form and long-form approach, the training programme for enumerators will need to be split in two. The training programme for the short form can be reduced considerably when compared with the training programme for the long form. The best enumerators should be used in those areas selected for the long form.

3.277   In the present chapter, the training programme that is discussed relates to the field operations staff (managers, supervisors and enumerators). However, note that additional groups of people may need to undergo training on the census. These groups can include regional government administrators and village heads, who may be involved in the coordination of census logistics in their particular areas of responsibility. These groups of people do not necessarily need to know all of the technical details associated with enumeration. However, they should be given a short training course so that they are familiar with the census framework and the responsibilities of staff working on the census. The course should impart an overall appreciation of the operations that will occur in their areas.

2.   Training programmes

3.278   Training is directly related to the procedural aspects of undertaking a specialized operation. Therefore, it is usually impractical to outsource the delivery of the training. However, it may be desirable to utilize professional trainers in developing the training materials and providing advice on training strategies.

3.279   In the present section, the methods described are referring to the training programme for the temporary staff, engaged on operational tasks directly related to the field aspects of enumeration. However, it is likely that many of the staff of the census agency engaged in managing the operational staff will themselves be relatively inexperienced in census work. It is therefore essential that they be given sufficient training to equip them for this work. Certainly the training will depend on the method used for collecting census information from the population. If methods such as CAPI are used, the training will certainly need to focus on a clear understanding of the electronic questionnaire and the use of the handheld mobile devices.

3.280   In many countries, key participants (such as regional managers and census agency staff) are brought together at the start of the field operations some months before census day. This is a cost-effective way of passing on the necessary information and providing a good

basis for team building among the staff. The duration of such a workshop is a matter of judgement by the census agency, taking into account such factors as:

(a) The nature of the staff who have been engaged;

(b) Their experience in census-related activities;

(c) The degree of change in processes since the previous census;

(d) The amount of time and resources available.

3.281　Training should be delivered as close as possible to the time at which it is to be used. This applies to the field operations phase of the census as well as to other aspects of the cycle. In the field operations phase, this can be particularly difficult. This is because there are usually large numbers of staff to be trained, over a large geographical area, in a short period (typically three or four weeks).

3.282　The training should aim at equipping senior staff with a high level of understanding regarding both their specific roles and the nature and relevance of the census. Senior staff can share this understanding with lower-level staff as needed. It is therefore important that the senior staff be well trained, with particular focus on understanding the importance of their duties and their contribution to the overall census goals.

3.　Trainers

3.283　An effective way of undertaking training is to follow a cascade principle, whereby each level in the staffing hierarchy trains the level immediately below it. Using this principle, the regional managers are trained by staff from the census agency; the regional managers then train the deputy regional managers, who in turn train the district managers, who train supervisors, who train the enumerators.

3.284　A further consequence of this cascade approach is that each layer in the hierarchy must receive some training in how to train the next level. Where possible, the importance of this training function should be emphasized in the selection of staff, in the census agency as well as the more senior field staff. The number of layers in the training cascade needs to be as few as possible.

3.285　Another method employs master trainers who are responsible for training staff in particular geographical regions. These trainers would initially undergo training (often referred to as training of trainers) in the census agency. They are then responsible for training staff in a particular geographical region. However, while these trainers can undertake some face-to-face training and coordinate training in their regions, it is unlikely that they will be able to train all staff. Therefore, some field staff will have to undertake training as part of their duties.

3.286　In some cases the master trainers are specialist staff from the census agency, while in other cases the master trainers will be temporary employees. If temporary employees are used, it is important that they be given adequate training and time to become completely

familiar with the concepts and issues associated with census enumeration. Permanent staff from the census agency should also carry out spot checks when these trainers are training other staff to ensure that they are conducting the training sessions correctly.

3.287   A common cascade training scheme is:

(a) Census key subject matter persons train census directors;

(b) Census directors then train census supervisors;

(c) Census supervisors then train census crew leaders;

(d) Census crew leaders then train census enumerators;

(e) Daily visits by census key subject matter staff are organized during the training sessions;

(f) The census office conducts centralized workshops after the training of the supervisors and after the training of the crew leaders for open discussions on fieldwork activities and responsibilities.

4. Developing training material

3.288   It will usually be the responsibility of census agency staff to develop materials (handbooks, instruction kits, training packages and videos) to support the activities of the collection staff. Care and attention in the development of these materials is needed. The standard application of these materials is crucial if a consistent approach to enumeration is to be adopted across the entire country. High-quality training guides and videos will make it more likely that the approved, standard procedures will be used with consequent high-quality outcomes. It is to be expected that trainers will use their initiative in developing ways of applying these materials that satisfy both their own personality and style and the needs of their audience. This should be encouraged, and training staff should be encouraged to pass along suggestions on methods they have found to be particularly effective.

3.289   Some countries make extensive use of video as a training tool in certain parts of the training cycle to ensure homogeneity of training outputs.

3.290   In countries with multiple languages or those with an official language and a variety of local languages, careful consideration has to be given to concepts and words used. The appropriate translations of concepts should first be identified, documented, and recorded, and then used in the practical training sessions.

5. Training by level of field staff

3.291   In preparing training sessions, the requirements of each group of trainees should be considered. The organizer of the course will need to undertake the following:

(a) Set the goals of the session for each group;

(b) Plan the session using the guide, goals and materials;

(c) Prepare any additional materials required;

(d) Practise the session, testing all visual and technical aids;

(e) Ensure the venue is set and seating is arranged in an appropriate manner.

3.292   During formal training courses, certain techniques can be used to lay the foundation for success. These include the following:

(a) Knowing the subject matter;

(b) Following the standard training guides to ensure consistency of training;

(c) Encouraging trainee participation;

(d) Conducting practical exercises, including role play and mock interviews;

(e) Looking for and overcoming signs of fatigue and boredom (for example, have regular breaks and ask questions of those losing concentration);

(f) Sticking to the main issues and not getting bogged down with discussions that are tangential;

(g) Sharing realistic experiences in the field that may arise and teaching how to overcome resistance;

(h) Dealing separately with persons within the group who need special attention.

5.1   Training regional managers

3.293   The census agency will also provide continuing support and assistance to the regional managers throughout their period of duty. This can be achieved through visits by agency staff or frequent telephone contact at periods of more intense activity. This can be regarded as a form of on-the-job training. In addition, these staff must be provided with a printed manual setting out details of the procedures to be followed. If appropriate facilities are available, these senior staff may be supplied with computers enabling them to contact the census agency for advice by using the Internet or other networks.

3.294   It is usually convenient for the senior temporary staff to receive several days of classroom-based training. As they will be employed for a relatively long period, perhaps several months, it may be effective for the training to be split into separate phases, as follows.

(a) Immediately after appointment, the first phase deals with initial tasks such as familiarization with the area, recruitment and training of lower-level staff, and establishing contact with local stakeholders.

(b) The second phase, for one day as close to census day as possible, deals with the tasks to be expected in the enumeration activity, including quality monitoring, throughput monitoring, and remuneration processes.

3.295   An example of the issues to be covered in a training course for regional managers is given in table 11. It will be necessary for countries to adapt the model presented according to

the needs of the census methodology they adopt. Countries that also employ deputy regional managers should develop a course specifically for that level, basing it on a shortened version of the regional manager course.

Table 11

Example of training course for regional managers (phase one: modules 1–10)

Module	Content
1. Introduction	Introduction of staff to one another
	Introduction to the census
2. Administrative systems	Overview of the role and tasks of the regional manager with an emphasis on quality management
	Procedure for communications among regional managers and with the census agency
	Overview of collection operation computer systems (if applicable) Clerical administrative procedures
3. Occupational health and safety for enumeration staff	Safety guidelines and procedures Incident reporting
4. Form distribution and return	Logistics
	Timetable
	Effect of logistics on quality
	Role(s) of staff by level
5. Recruitment of staff	Advertising
	Selection of staff
	Administrative procedures for appointment
6. Financial matters	Budgeting
	Administrative procedures for expenditures
	Procurement of material by collection staff
7. Training techniques	Train-the-trainer techniques
	Training deputy regional managers and supervisors
8. Mapping	Use of maps in planning workloads
	Use of maps to manage operations
	Managing operations in areas where maps are deficient

Module	Content
9. Special enumeration strategies	Communal/special dwellings
	Other groups requiring special strategies
10. Remuneration/payment of collection staff	Basis and rates of payment
	Timetable for payments to each level of staff
	Role of regional manager
	Procedures for payment system
Course review	Brief review of progress in each region

3.296   The model is based on two phases of formal training, covering 14 modules. The training sessions should also include review sessions, as shown.

3.297   It is suggested that, where possible, the course be conducted on a residential basis. This will encourage the managers to get to know one another and the census agency staff and will assist in establishing the effective communication paths that are necessary during the field operations.

3.298   It is also suggested that a class size of 10 to 15 persons is appropriate for this course. Where there are significant differences in procedures required between regions (for example, several regions in an urban area and others in the rural hinterland), it will be desirable to group the managers from similar regions together.

3.299   The first phase covers the initial tasks and administrative procedures relating to the work of the regional managers. This should be scheduled just before the work begins, and should be planned for approximately three days. Depending on the aptitude and experience of the managers, it could be extended to four days.

3.300   The second phase (table 12) covers tasks that are important in the actual enumeration period. This will take at least one day and, if time is available, could be extended to a second day.

Table 12

Training course for regional managers (phase two: modules 11–14)

Module	Content
Brief review of progress in each region	
11. Public communications and enquiry services	Review of public communications
	Plans for advertising campaign during enumeration

Module	Content
	Plans for enquiry services, including (where appropriate) telephone hotline and use of the Internet
12. Review of recruitment processes	Matching staff to workloads
	Review of quality of staff appointed
13. Review of special enumeration strategies	Rationale and procedure for special strategies
14. Quality assurance in enumeration	Role of regional manager
	Procedures for refusals

5.2   *Training deputy regional managers*

3.301   As indicated in chapter II, section D, the role of a deputy regional manager may be essentially that of an administrator. If this structural model is used for the field operations workforce, it is suggested that the regional manager deliver their training course.

3.302   The course should be approximately one full day in length and comprise the following modules from the regional manager training course above:

1. Introduction (with a focus on the role of the deputy regional manager)

5. Recruitment of staff, with a focus on administrative procedures

6. Financial matters

7. Training techniques

10. Payment of collection staff

3.303   In this situation, it would be appropriate for these modules to be given less emphasis in the regional manager training, and for relatively more emphasis to be given there to the quality management and training modules. It would also be necessary that the administrative procedures to be followed by deputy regional managers be clearly specified in manuals and other documentation, since there would be less direct contact between the census agency staff and the administrators.

5.3   *Training supervisors and enumerators*

3.304   The training of these staff can use a range of training methods, including the following:

(a) Home study exercises;

(b) Classroom training sessions;

(c) On-the-job training.

(a) Mainstream supervisors and enumerators

(i) Home study exercises

3.305   Home study exercises are designed to familiarize the field staff with their work before attending classroom training sessions. Completion of a home study exercise ensures that field staff read their manuals, prepare themselves for the training, and identify areas of confusion, all before attending training.

3.306   As the study material is returned to the trainer before the training actually commences, the trainer can determine if there is a consistent problem across the entire group or whether just one, or a few, people are having specific problems. In essence, an analysis of home study exercises can provide the trainer with insight into where and how to focus priorities.

3.307   To gain maximum value from this process, it is important that the documentation, including the manuals and home study exercises, be delivered to the participants well before training is to commence.

3.308   A typical home study exercise would require written answers, or completed questionnaires, to be returned and examined. Topics likely to be addressed for an interviewer-based census would cover all or most of the following:

(a) Rationale for the census and its use;

(b) Confidentiality;

(c) Roles of supervisors and enumerators;

(d) Receiving, checking and accounting for material;

(e) Coverage;

(f) Definitions of certain topics (for example, labour force status and occupation);

(g) Sequence guides;

(h) Procedures on the doorstep;

(i) Procedures for interview;

(j) How to handle respondents who refuse to participate in the census;

(k) Training on technological systems and procedures;

(l) Checking and editing completed material.

3.309   Supervisors would have some additional questions covering the following:

(a) Materials checking procedures;

(b) What to watch for in observed interviews, and recording of information;

(c) Managing poorly performing interviewers;

(d) Quality assurance checks;

(e) Editing;

(f) Materials collection.

3.310   These study exercises can contain approximately 20 questions for interviewers, and the same 20 and approximately 15 more questions for supervisors. The questions should be clear and unambiguous.

3.311   It is essential that the trainers have access to a complete set of accurate answers, enabling correction and analysis prior to the commencement of training.

(ii)   *Classroom training sessions*

3.312   The amount of time spent in classroom training will vary considerably between countries and will depend on, among other things, whether the census is interview or self-enumeration based. With an interviewer-based census, more time will be needed to train the enumerators.

3.313   A model of the issues to be covered in training courses for supervisors and enumerators is given in table 13. It will be necessary for countries to adapt the model presented according to the needs of the census methodology they adopt.

a.   Supervisors

3.314   Supervisors should complete a home study exercise to familiarize themselves with their duties and to introduce them to the enumerator's handbook (or instruction manual) before they attend their formal training session. Supervisors should return their completed home study exercises to the regional manager before their formal training to enable an assessment of their understanding of procedures.

Table 13

Training course for supervisors

Module	Content
1. Introduction	Introduction of staff to one another
	Introduction to the census
2. Confidentiality	Importance of confidentiality
	Procedures to be followed by supervisors
	Procedures to be followed by enumerators
3. Dispatch and return tasks	Transport arrangements for supervisors
	Material to be distributed
	Distributing material to enumerators

Module	Content
4. Definitions and mapping	Definitions of key characteristics, as employed in the census, which should include age, usual residence, types of housing and other characteristics determined by the country
	Introduction to census maps
	Use of maps in review of supervisor's area of responsibility
5. Implications of IT	Relationship between field operations and processing phases
	Use of digital systems in collection operation (if appropriate)
6. Enumeration staff recruitment	Enumerators
	Other field staff
7. Enumeration staff training	Enumerators
	Other field staff
	On-the-job quality assurance
8. Enumeration procedures	Role of supervisor
	Role of enumerator
	Role of other field staff
9. After enumeration	Quality assurance of workloads
	Preparation of material for transport to the processing centre(s)
Review of course	

b. Enumerators

3.315   The details of duties at this level are greatly influenced by the basis of enumeration, local conditions and overall administrative requirements. Therefore, only an outline of the course is given:

(a) Welcome and introduction to the census;

(b) Confidentiality;

(c) Role of enumerator;

(d) Occupational health and safety;

(e) Administrative issues;

(f) Definitions, mapping and other concepts;

(g) Special enumeration strategies;

(h) Duties of enumerators and procedures to be employed before contact with households, and during contact with households;

(i) Quality assurance of completed forms or digital questionnaires;

(j) Preparation of forms or tablets for transport to supervisor.

(iii) On-the-job training

3.316   For enumerators, on-the-job training, where enumerators are accompanied by their supervisor for a few interviews (or deliveries to households, if a self-enumeration approach is used), is particularly relevant to ensuring that they understand their tasks and perform them correctly. The supervisor should assess the relative abilities of the enumerators and manage their time so that the weakest enumerators receive the greatest level of support.

(b) Specialist enumerators

3.317   Some countries may also employ specialist staff to enumerate population groups that require particular consideration. Examples of such groups could include people in communal dwellings (such as hospitals, prisons, boarding schools or hotels) or members of distinct cultural or language groups. Where there is sufficient need, it may be necessary to establish specific training schemes for these staff. As the range of possible situations is wide, no prescription for such schemes is offered in the present handbook. However, the training should follow the same principles as the mainstream courses and, where possible, use the same materials to promote a standard outcome.

(c) Administration training

3.318   As indicted in other parts of the present handbook, a large undertaking such as the field operations phase of a census requires staff to follow a wide range of general administrative procedures. These procedures relate to the terms and conditions of their employment, rules or laws relating to the security and privacy of census materials, and other rules relating to the proper behaviour of government employees. As administrative tasks become increasingly automated using digital technology, training must ensure that employees are comfortable with using the technology necessary to fulfil their administrative obligations.

3.319   It is important that staff receive some training in these matters; otherwise, they will be unable to perform their duties effectively. At worst, it may create situations that cause significant adverse publicity for the census or the census agency in general. However, it is important that administrative training not detract from operational training. The staff are employed to collect high-quality statistical information from people, and pass this on to the census agency within an agreed timetable and at the highest level of accuracy. The collection staff are not to be employed to fill in administrative forms.

(d) Health and safety training

3.320   Even in the most effectively run census, there will be situations that pose a risk to the well-being of field staff. Ways of minimizing these potential risks should be covered in the training for all levels of field staff. The matters covered could range from correct methods for

handling enumeration materials to managing encounters with domestic animals. Training in this area should concentrate on the more common occurrences rather than on those that rarely occur.

3.321   The training must itself be carefully managed, to avoid overemphasizing the risks, which can create a victim mentality in the staff. It is usually possible to alter the presentation to stress attaining the positive rather than recovering from the negative. For example, people should be trained in the correct way to lift boxes of forms, rather than listing the health risks from poor techniques; they should be given tips on how to avoid dog attacks rather than on how to submit a compensation claim when bitten.

(e)   Computer systems training

3.322   Following widespread acceptance of the Internet and digitally based communications, many national statistical organizations are adopting data collection systems that heavily rely on technology. If such a system is to be applied, the staff that will operate the system must be given sufficient training in the use of the application. Even if familiarity with computers is a criterion for selecting staff, it cannot be assumed that the selected people will be familiar with the specific software used by the census agency.

3.323   If this element of training is undertaken successfully, the probability of a high-quality outcome from the census can be dramatically enhanced. To do otherwise risks staff becoming more concerned with learning to operate computers than focusing on their key roles.

3.324   As well as formal training in the initial courses, care must be taken to provide online reference material for the computing system and a readily accessible help-desk facility within the census agency.

H.   Logistics for census materials

3.325   The logistics for census materials will depend largely on whether the census uses a paper or electronic questionnaire. In the case of a paper questionnaire, it will depend on whether the data are manually keyed or scanned in. Whatever the method of data capture, there are other documents that will need to be prepared. It is important to prepare for the logistics for the census materials early in the census-planning process, since it may take time for the materials to be printed or for electronic devices such as tablet PCs to be purchased and set up correctly.

1.   Printing of forms and other documents

3.326   Printing the many items that are required to conduct census enumeration is a major activity. The main census questionnaire is the most obvious item, but there are many others that need to be printed. Given the size of the census enumeration task, the amount of printed material is often large, and significant lead time needs to be taken into account.

3.327   For each item, printing requirements need to be established, quantities calculated, items specified and production undertaken. The packing and dispatch of materials into the

field (see chap. III, sect. I) relies on the timing of the printing process, and careful planning and coordination of these activities are necessary.

3.328   In the majority of countries, printing will be conducted outside the census agency, either through a government printer or commercially. Part of the preparatory process for the census is investigating the country's printing capacity on the basis of broad requirements. Early discussions with major printers should be undertaken. Before proceeding to select the printer, census agencies may wish to seek specialist advice from printing consultants or other census agencies. The census pilot is a good time to test the quality of printing.

1.1   Types of forms

3.329   There are six broad groups under which printing-related services will be required. These are as follows:

(a) Census questionnaires;

(b) Post-enumeration survey questionnaires;

(c) Procedural items;

(d) Training items;

(e) Other enumerator items;

(f) Administrative items.

(a)   Census questionnaires

3.330   The importance of the main census questionnaire is so great that it should be treated as a separate printing activity from the other groups specified above. It is important that the census agency deal directly with the printer and that other stakeholders (such as processing staff) be involved in all stages of production. This is especially the case if the print quality is crucial for the processing system, for example where OMR is used.

3.331   The census enumeration will often include more than a single type of form (for example, personal forms and household forms). There may also be a combination of self-enumeration and interviewer forms where these two methods of enumeration are used in combination.

3.332   In some countries the main census questionnaire may be preprinted, with identifiers for different geographical regions of the country. There may also be slight differences in some questions because of differing circumstances throughout the various regions of the country.

3.333   There may also be other forms that will be needed in lesser numbers for enumeration in remote areas, or forms used to summarize details of persons enumerated in special dwellings such as hotels, hospitals or prisons.

3.334   There are three important issues to consider when organizing the printing of census enumeration forms:

(a) Quantity;

(b) Quality;

(c) Timing.

(i)   Quantity

3.335   Estimating the quantity of forms to be printed is discussed in detail in the section on distribution and return of materials (chap. III, sect. I). Running out of forms during the enumeration can have serious consequences as there may not be enough time to print additional quantities. However, printing excessive numbers of forms wastes resources and adds unnecessary costs to the census operations. Thus, great care must be taken in estimating the number of forms required.

3.336   Quantity estimates are also important to make sure that the paper stock required for printing the forms is available. Therefore, these estimates should be made as early as possible. This is particularly important in countries where additional quantities of the required paper stock may need to be produced for the census. Sufficient time must be allowed for paper mills to schedule additional production or import additional stock.

(ii)   Quality

3.337   The quality of the printing job of the forms can be crucial to the quality of census data. Mistakes on the form (for example, incorrect question wording or incorrect sequencing instructions) can result in data items being missed or completed erroneously by interviewers or householders. Also, it is important to make sure that the printers receive the final versions of the documents to be printed.

3.338   Second, the paper stock used for the census forms is important. Make sure that the paper is of sufficient quality to handle conditions in the field. Also, be sure that the desired paper stock is available to print the quantity required for the census enumeration.

3.339   Further, special attention should be given to ensure that printing adheres to standards required for the data-processing systems. These standards may refer to the positioning of response areas, colours of the form, and paper quality and type. For example, some data-capturing systems cannot use recycled paper because of the impurities in the paper. Deviation from these standards may result in data quality problems and costly corrections in the processing phase.

3.340   Procedures that can be implemented to monitor the quality of form printing are discussed later in the present chapter.

(iii)   Timing

3.341   Planning of the printing process needs to take into consideration the long lead times that may be required. The quantities required may place a large burden on the available printing capacities in the country. Early discussions with printers will give an indication of the lead time required to print sufficient quantities of forms. Planning should include, but not

be limited to, the activities set out in table 14, with a broad indication of timing in relation to the census date. The timings shown in the table are regarded as the ideal lead times required, although it is recognized that these lead times may not be possible in some countries. It should also be noted that countries with small populations may be able to condense this timetable.

3.342   Further, it should be noted that in most cases the packing and dispatch of the printed forms should occur progressively and concurrently with the printing.

Table 14

Printing activity timetable

Activity	Months before census
Preparation of technical specification (draft)	24
Preparation of technical specification (final)	23
Provision of contractual wording and advice	22
Review of tender document	22
Calling tenders	21
Evaluation of tenders	18
Management review	16
Letting/awarding of the contract	15
Preparation of manuscript	15
Typesetting	14
Printing and quality assurance (start)	12
Printing and quality assurance (finish)	8

(b)   Post-enumeration survey questionnaires

3.343   If a post-enumeration survey is being conducted, then the printing of the post-enumeration survey questionnaires should be planned at the same time as the printing of other census materials. This is to ensure that the post-enumeration survey questionnaires will be ready for fieldwork as soon as the census enumeration finishes. Waiting until the census enumeration ends to print the post-enumeration survey questionnaires may delay the post-enumeration survey fieldwork and could jeopardize the data quality of the post-enumeration survey.

3.344   Many of the issues discussed above for the main census questionnaires will also apply to the post-enumeration survey questionnaire.

(c) Procedural items

3.345   This group of items includes the set of forms needed to track the enumeration progress:

(a) Enumerator's record book;

(b) Supervisor's record (or management) book;

(c) Regional manager's or deputy regional manager's control book;

(d) Objection or refusal forms for enumerators to report cases of refusal.

(d) Training items

3.346   This group of items includes the instructions and guidelines that document how the census enumeration will be conducted. The items that may be included in this group include:

(a) Enumerator's manual;

(b) Materials for training exercises for the enumerators;

(c) Enumerator's prompt cards, which summarize procedures in point form for quick reference;

(d) Supervisor's manual;

(e) Materials for training exercises for the supervisors;

(f) Instructions for training enumerators;

(g) Regional manager's or deputy regional manager's handbook or management book and home study exercise;

(h) Special enumeration instructions;

(i) Enquiry service instructions.

(e) Other enumerator items

3.347   These items are those used by the enumerators in their work and may include some or all of those listed below. The list is not prescriptive or exhaustive but illustrates the type of items that may be required in addition to the questionnaires and the listing book. A common attribute of each of these items is that if they are used, they will be required in large numbers. The printing of enumerator items should be planned around the printing of the main census questionnaire, as these items will usually be packed together for delivery to field staff. Items that may be used by the enumerators include:

(a) Identification cards for enumerators, supervisors, regional managers and other census field staff;

(b) Information booklets or pamphlets that explain the taking of the census, which are sometimes handed to each household by the enumerator or delivered by mail to households before enumeration commences;

(c) Multilingual brochures to help enumerators to communicate with householders who are not proficient in the principal language of the country;

(d) Calling cards, which enable enumerators to inform a household when they will return to collect the completed form (if applicable in a drop-off and pickup scenario);

(e) Non-contact cards, which enable enumerators to let households know they have not been able to contact them and what to do;

(f) Privacy envelopes, which enable householders to mail their form back or prevent the enumerator from seeing it.

(f)   Administrative items

3.348   This group includes all the forms and letters used in the administration of the census enumeration. It can amount to a large number of individual items, although some may be only a single page or of a relatively small quantity. The list below breaks these items into categories and gives some examples of the type of forms that may be included in each category. The list is not prescriptive or exhaustive, and the items to be included will largely depend on the nature of employment in the country. Categories and examples include:

(a) Recruitment and appointment:

- o   Application form for enumerator position
- o   Application form for supervisor position
- o   Interview form
- o   Offer of employment form (or contract)

(b) Finance and taxation:

- o   Advice on payment
- o   Taxation forms
- o   Other financial forms

(c) Control forms:

- o   Record of attendance at training
- o   Record of receipt of materials
- o   Record of quality assurance on completed workloads
- o   Record of return of materials

(d) Letters and notices:

- o   Approach letter to special dwellings
- o   Letter to persons objecting or refusing

(e) Labels:

- o   For completed census materials
- o   For unused census materials

o   For administrative materials.

1.2   Planning and management of printing

3.349   Planning and managing printing required for the census enumeration is relatively straightforward. The most difficult aspect may be the coordination involved in obtaining sufficient information from specialized areas within the census operation that require items to be printed (for example, recruitment procedures, training and payment).

3.350   Steps involved in planning the printing process include the following:

(a) Establishing the timetable for the preparation of manuscripts by the relevant areas of the census agency;

(b) Estimating the quantities of each item required (the estimates should as accurate as possible and should not result in shortfalls or significant oversupply);

(c) Specifying the details of the individual items to be printed;

(d) Setting up processes to obtain information and quotations;

(e) Establishing contracts or other formal arrangement for the printing;

(f) Managing the printing activity.

3.351   Two tools useful for planning and managing the printing of census materials are the printing specifications form and the cost and quantity sheet.

(a)   Printing specifications form

3.352   A printing specifications form is a convenient way to record the printing requirements for each item to be printed. The specifications should contain enough detail for printers to provide reliable quotations of costs and printing timetables, and for logistic support staff to develop plans for packing. Table 15 shows examples of items that may be included in a printing specifications form. A printing specifications form can be attached to a pro forma invoice to document printing requirements to the printers. Be sure to update any information on the printing specifications form as the requirements change.

Table 15

Printing specifications form

Category	Notes	Item 1	Item 2, etc.
Description	Describes the purpose of the item		
Quantity	Includes any notes about how the quantity was determined		
Stock	Type of stock the item is to be printed on (e.g. paper, cards)		
Ink	Colour or colours of the print		

Category	Notes	Item 1	Item 2, etc.
Binding	Type of binding if multipage document (e.g. stapled, perfect bound, folded)		
Packing	How the printer is to pack the item (e.g. bundles of 40, pads of 70)		
Delivery	Location and dates; includes a breakdown if there are large quantities		
Manuscript	When and how the manuscript will be provided by the census agency		
Proof	Details about whether and when proofs will be required and how they will be checked		
Quality assurance	Details about sample requirements before or during the main production run		

(b)   Cost and quantity sheet

3.353   The next step is to establish a method for recording the cost and quantity of all items to be printed. Estimated, quoted and actual costs can be recorded. The use of estimated costs initially enables a running total to be kept that is updated as quotations are obtained and again when actual costs are known. This information allows the total printing budget to be monitored and provides early warning if unexpected increases in costs appear likely to threaten the budget. Again, the use of a spreadsheet is ideal for this task. The following information might be recorded on the spreadsheet, which can also be used for management information purposes:

(a) Item name;

(b) Supplier;

(c) Estimated quantity (used if there is a variation between seeking quotes and what is finally printed);

(d) Quoted cost;

(e) Estimated cost;

(f) Printed quantity;

(g) Actual cost;

(h) Date ordered;

(i) Date delivered.

1.3   Quality assurance

3.354   As stated above, the quality of the printing process can have a profound impact on the final quality of the census data. It is therefore important that a quality assurance scheme be devised whereby printing is closely monitored throughout the entire process. This should extend to the checking of proofs and production runs.

3.355   The census form is the most important form and therefore should be subject to intensive quality assurance checks in both the proof and the production stages. The other items are normally only subject to intensive constraints in the proof stages and not in the production stage. This reflects the lack of technical requirements for extreme precision of the physical placement of characters in these other items and the high cost of production checks.

(a)   Checking of proofs

3.356   As material is developed, it will progress through several proof stages before it is finally typeset for the printing process. At each stage, proofs should be checked and authorized as correct by the project leader responsible for form design. Additional checks by staff not directly involved in the form design process can also prove useful in detecting discrepancies.

3.357   In some situations, the final typeset proof used for printing is the responsibility of the printer. In these cases, the typeset version should be checked and approved by the census agency before printing commences.

(b)   Production runs

3.358   As the printing process progresses, a sample of census forms should be selected for quality assurance checks. Issues such as resources available and the level of problems detected will affect the size of the sample selected, and the sampling strategy.

3.359   However, it is important that sufficient resources be allocated to ensure the quality of the printing process. Otherwise, significant costs may be incurred in the processing phase to rectify mistakes resulting from printing errors. If these mistakes cannot be rectified during processing, problems in the final census data may occur.

3.360   Sampling rates can be adjusted throughout the printing process, with higher rates at the beginning of the printing. Where the printing technology includes the creation of new printing plates after some proportion of the work has been completed, a higher sampling rate should be employed after each new set of plates is produced. The sample rate can be adjusted downwards if detected problems decrease. However, a sample should be taken over the entire printing process from start to finish. It cannot be assumed that, if the quality is good at the beginning of the print run, this will necessarily continue.

3.361   It is also preferable that quality assurance is conducted at the printing plant. This will assist in the early detection of problems. However, agencies should not rely on the printers themselves to conduct all quality assurance checks. Independent checks need to be carried out.

3.362   Examples of some of the checks that can be made on the forms include:

    (a) Horizontal and vertical trimming;

    (b) Positioning or skew of response areas on the actual page;

    (c) Page numbering and correct order of pages;

(d) Colour, including any smudging;

(e) Strength of any binding.

3.363   Particular attention should be given to any specialized printing requirements that are required for data-capturing systems. A final check should be undertaken by processing a sample of forms through these systems to enable a comparison of actual versus expected results.

3.364   Box 25 presents some examples of potential pitfalls during the printing process and how they can be avoided.

Box 25. Avoiding pitfalls during the printing process: examples

An African country during the 2010 census round

Printing of questionnaires should be done well in advance. During the 2010 census round, in one African country, census printing of questionnaires was a major bottleneck, which almost threatened the successful completion of the exercise. The government printer was responsible for printing questionnaires. Assurances were given that the printing would be completed before the start of the enumeration period. At the last minute it was realized that it was not possible for the government printer to print the required number of questionnaires by the enumeration date.

This constraint was so serious that if it was not promptly addressed the whole census programme could have been derailed. Other small printers, in addition to the government printer, were used in printing the questionnaires. The printing continued while enumerators were in the field. As a consequence of this problem, printing was done round the clock and in a hurry, thereby compromising quality in some cases. As a result of the printing constraint, enumeration work was extended by a number of days in some areas; printing costs increased owing to the overtime costs associated with the use of private printing presses; and transport costs increased because vehicles were sent from various provinces to collect printed questionnaires, in small batches, from the capital city, where most of the printing was undertaken.

Indian census 2011

For the Indian census in 2011, the questionnaires were printed in 16 languages. The estimation of the questionnaire requirements for each language was based on the population figures for various languages spoken during the preceding census. Language-specific printing was assigned to suitable high-end presses, which were geographically far apart from each other. Any communication gap between the coordinating officials and the printing establishments could lead to disproportionate printing, which could adversely affect the questionnaire requirements for each language, with a ripple effect on such matters as reordering, logistics and timing of enumeration.

Indonesian census 2010

The procurement process for questionnaires for the Indonesian census of 2010 included two main specifications, according to whether the data recording was undertaken using scanners or not. Almost all main questionnaires were printed in a form that could be scanned, except for those to be used in remote areas. The procurement specifications for the scanner-based questionnaires included a high-precision layout, with the thickness of red and black components, the serial number, and the position of dividing lines all precisely located for accurate recording by the scanner. In order to meet the demand for these high-requirement questionnaires, the procurement process was offered to private printing companies through open bidding, and included several round of test printing. As a result, few printing problems occurred.

2. Preparing equipment for an electronic questionnaire

3.365   If using an electronic questionnaire, the equipment to be used for data collection (tablet PCs, smartphones or other handheld devices) must be prepared and distributed to the enumerators. This is a major task that requires careful planning and management. As with the printing of questionnaires, sufficient time needs to be allocated for preparing the electronic

equipment for census enumeration, especially given the large amount of equipment generally required when conducting the enumeration using an electronic questionnaire.

3.366   Steps to consider in preparing equipment for an electronic questionnaire include procurement, setting up the equipment to correct specifications, quality control, technical assistance, and distribution and collection of the equipment.

2.1   Procurement of electronic equipment

3.367   The first steps in preparing equipment for an electronic questionnaire are to identify the right equipment, estimate the required number of items of equipment, obtain quotes for the estimated cost of the equipment, and finally acquire the items. The process for these steps is discussed in chapter II, section J.

3.368   If the equipment must be imported, further consideration should be given to the amount of time it takes for shipments to arrive in the country. Having early discussions with the equipment suppliers is an appropriate approach to obtain an estimate of the time required for acquiring the equipment, thereby ensuring that there is sufficient time to set up the equipment to the correct specifications before training begins. Creating a timetable for equipment management may be helpful.

2.2   Setting up the electronic equipment

3.369   Each device needs to have the necessary software, along with the correct settings for data security, Internet and network access, and enumerator identification. Specifications should be developed for setting up the device for enumeration. See chapter II, section L, on use of technology, and chapter V on data processing, for additional details about how to develop the specifications.

3.370   A decision should be made on who will set up the devices. The devices can be set up by staff of the census agency or another government agency (at either the national level or the regional level), by the supplier, or by outside contractors.

3.371   Depending on the number of enumerators to be deployed, this process may require long lead times. It is important to allocate enough time for setting up the devices to make sure that it is done correctly and in time before the training.

2.3   Quality assurance

3.372   The quality of the equipment and how the equipment is set up have major consequences for the quality of the data collected. Equipment failure or incorrect specification of equipment could have a detrimental effect on data quality. Quality control needs to be performed on each device to ensure smooth census enumeration. Also, it is important that all devices be set up in the same way. For example, all devices should have the same version of the software used for enumeration.

3.373   Each device needs to be thoroughly tested. A checklist for this may include:

(a) Device is working correctly;

(b) Correct version of the software is installed;

(c) All necessary software is loaded correctly;

(d) Internet, network and Bluetooth connectivity is working correctly;

(e) Battery power is sufficient.

2.4   *Planning for distribution and collection of the equipment*

3.374   Care should be taken to plan for the distribution and collection of the equipment. Lost or damaged equipment could have significant cost implications. Setting up a system for accounting for each device is critically important. Chapter IV discusses the plan for distribution and collection of the equipment in more detail.

2.5   *Technical support*

3.375   In addition to the training provided to enumerators, it may be advisable to set up a system of technical assistance to support the enumerators if any technical issues develop during the enumeration. During the 2010 round of censuses, a number of countries introduced electronic devices for field enumeration; thus, there is a body of national experience regarding technical issues that require technical support. As the use of such an approach becomes more frequent, it is expected that most technical issues are resolved before the start of field enumeration; yet, there will certainly be a need for establishing technical support teams at multiple locations that would be in a position to address any issues arising in a prompt and efficient manner.

I.   Distribution and return of materials

1.   Introduction

3.376   In many countries, the distribution and return of materials in the field operations phase will represent the largest peacetime movement of materials for any single exercise. As a logistics operation, this activity will be referred to as distribution and return tasks.

3.377   Distribution and return of materials is the term used to cover tasks associated with materials that are:

(a) Supplied to a packing centre;

(b) Distributed to field staff;

(c) Picked up from field staff;

(d) Returned to data-processing centres.

3.378   The tasks include the following:

(a) Receipt of material from manufacturers (for example, printers) and other external suppliers, which could include the census form and materials needed for packing (such as boxes and tape);

(b) Bulk storage during the packing operation;

(c) Packing;

(d) Consignment preparation and delivery to enumeration staff;

(e) Bulk transport outward;

(f) Pickup from enumeration staff;

(g) Bulk transport inward to processing centres;

(h) Close-down operations.

3.379 Regardless of the type of census, there will be a need for materials to be supplied to field staff and returned. For example, even in the case of a mail-out/mail-back census, there is usually a field follow-up component for which materials, including manuals and administrative supplies, will be required. In these cases, the volume of material would be relatively small, but there is still a need to plan and implement these activities. Specific issues regarding using a postal service for a mail-out/mail-back census are discussed in section I.7 below.

3.380 The majority of these tasks are usually carried out under contract by a government transport service or commercial operator, although the packing of materials may be done within the census office in some countries. The contractor will use specifications and consignment details provided by the statistical agency. If the volume is small, the postal service may be a feasible method.

2. Inputs

3.381 As a first stage in this process, decisions must be made concerning the nature and responsibilities of the centrally controlled distribution and return operation. Will deliveries be made to regional managers or to supervisors? Will enumerators be required to collect their work from a more central depot? These decisions must be made by national statistical organizations, keeping in mind such factors as the amounts of material to be transported, the transport available to field staff, and the condition or existence of roads or other means of transport.

3.382 Once these decisions have been made, the key inputs to the dispatch and return of materials are as follows:

(a) Workload estimates from the mapping programme to establish packing volumes for transport requirements;

(b) Workload estimates from the data capture program in case of a digital census, as well as secure packing;

(c) Name and address details from the recruitment activity to establish details on delivery and pickup points.

3.   Type of materials

3.383   The material to be transported generally falls into the following broad categories: (a) material for enumerators; (b) material for supervisors; (c) material for regional managers and deputy regional managers; (d) digital devices; and (e) material for other uses.

3.1   Material for enumerators

3.384   Material for enumerators comprises relatively few items, and includes the main census form for a paper-based census. Other items may include control forms, clipboards, pencils, sharpeners, satchels, notebooks, waterproof envelopes, uniforms, badges, ID cards, chalk or tablets. Waterproof kits are especially important for OMR/ICR questionnaires and digital devices. Questionnaires comprise the bulk in terms of volume, packing, storage and transport tasks.

3.385   This material can be packed centrally, transported in bulk to regions around the country, and then transported from there to supervisors. Supervisors then arrange for its delivery to, or pickup by, enumerators. This may also involve some recounting of the bulk materials into lots suitable for individual enumerators. Typically, each pack will comprise a standard amount of specific material. For example, this could be a number of packs of forms of a size sufficient to enumerate a specific number of households. The number of packs allocated to each workload may be specified centrally or by the supervisor.

3.386   At the completion of the enumeration, the material is usually picked up from supervisors, after quality assurance has been completed, and returned to the processing centres. It is imperative that all blank forms be returned to the centre.

3.2   Material for supervisors

3.387   This material includes the packing and transport of administrative and training material used by supervisors and includes the enumerator's record book and training and procedural manuals.

3.388   Again, this material can be packed centrally and then transported to each region. It can then be included with the transport of enumerator material to supervisors. It should be packed separately from the enumerator material because it may include material of a specific nature (such as maps for enumerators) or of variable quantity (such as enumerator's handbooks), depending on the composition of the workload.

3.389   After enumeration, this material is picked up from supervisors and returned to the processing centres, along with the enumerator material. Supervisors must make sure that all the forms, blank and filled, are accounted for and returned.

3.3   Material for regional managers and deputy regional managers

3.390   This material includes the packing of administrative and training material used by regional managers and deputy regional managers and includes material for supervisor training.

3.391   Because of the relatively small number of these staff, the material can be packed centrally and then transported directly to regional managers.

3.392   After enumeration, the material is picked up from the regional managers and the bulk returned to the processing centres. Some material that is not necessary for the processing phase may be returned to a regional or central office of the census agency. This material may include key administrative documents such as objection or refusal reports or payment details.

3.4   Digital devices

3.393   Handheld devices, if used as part of the data collection system, will need to be distributed to regional and local offices. The distribution and tracking of digital devices present different challenges from paper materials, which are in some ways less fragile and have no inherent monetary value.

3.394   Special care must be taken when shipping digital devices. Moisture is a concern for both paper materials and digital materials. Electronic devices may also be sensitive to vibration or sharp movements. Statistical offices should work with the suppliers of the electronic devices and, when applicable, the logistic contractor, to ensure that proper care is taken when devices are transported.

3.395   A system for ensuring that digital devices are used only for official purposes and are returned to the statistical agency must also be developed. Staff should understand that the care and safe return of any electronic devices used in the census is their responsibility and that they could be held financially liable for the devices, especially for their return at the end of field operations.

3.5   Material for other uses

3.396   In addition to the above, other material used in the field should also be included within the scope of the distribution and return activity. For example, this may include special forms used for certain population groups (such as in remote areas) and public communications material.

3.6   Specifications

3.397   A significant task in planning field operations is establishing the specifications for the packing and transport of materials. These specifications need to be developed regardless of whether these activities are carried out by the census agency itself or contracted out to another government agency or private company.

3.398   Planning for the packing, distribution and return of materials should begin, where possible and depending on the particular country, approximately two years prior to the census date. A contract should be in place at approximately the same time as the major printing contracts are established. In some cases, in particular where these operations are commercially based, savings can be made if printing and packing contracts are coordinated. For example, transport costs can be avoided if the printing and packing centres are co-located.

3.399   Tables 16, 17, 18, 19 and 20 present, respectively, information on specifications for the distribution and return of materials; packing of materials; dispatch of materials; return of materials; and evaluation and pricing.

Table 16

Specifications for the distribution and return of materials

Title	**Description**
Introduction	Includes a description of the census agency and the census
	Sets out the role of the activity and its overall goals
	Includes key dates and requirements
	Sets out the structure of the specification
Structure of census	Describes hierarchy of field structure, number of management units and enumeration areas
	Brief description of the role of each level in the structure
Overview	Brief description of the activity and its main components, and the goals of each component
	Describes key functions of the contractor
Preferences, mandatory requirements	Includes a description of any particular preferences and mandatory requirements, for example, the use of dedicated vehicles for census material in the return phase may be a mandatory requirement
	Not using subcontractors may be a preference
Privacy	Clearly states the census agency's policy on privacy and the requirements in this activity
Contract arrangement	Describes how the contract will be established and managed
Payment	Describes preferred payment basis and the basis on which quotations are being sought
Reporting	Basic reporting requirements

Table 17

Packing of materials

Title	Description
Introduction	Describes packing activity
Functions	Sets out and describes functions of the contractor: receipt of materials, storage and handling, packing and labelling, quality assurance, dispatch, return
Timetable	Detailed timetable for packing activities
Requirements	Detailed requirements for security, labelling, storage
Packing	Packing details: type of packs by level of structure, content of each pack type, quantities of each pack type
Reporting	Detailed reporting requirements

Table 18

Dispatch of materials

Title	Description
Introduction	Describes dispatch of material to field staff
Function	Sets out and describes functions of the contractor: receipt of materials from packing centres if they are different, storage and handling, preparation of consignments and labelling, quality assurance, delivery requirements
Timetable	Detailed timetable
Requirements	Detailed requirements on security of vehicles and obtaining signatures
Transport	Transport details: description of drop-off method and requirements, description of control documentation requirements, description of consignment details and volume, method of supply of field staff names and addresses, description of control documentation requirements, handling shortfalls and surpluses
Reporting	Detailed reporting requirements

Table 19

Return of materials

Title	Description
Introduction	Describes pickup of material from field staff and return to the processing centre(s)
Function	Sets out and describes functions of the contractor: pickup of materials from field staff, security requirements, storage and handling, delivery to processing centre, reconciliation of materials, delivery requirements
Timetable	Detailed timetable
Requirements	Detailed requirements (e.g. security of vehicles and obtaining signatures)
Transport	Transport details: description of pickup method and requirements, description of control documentation requirements, handling shortfalls and surpluses
Reporting	Detailed reporting requirements

Table 20

Evaluation and pricing

Title	Description
Introduction	Describes how quotes for the contract will be evaluated
Evaluation criteria	Describes evaluation criteria for each task: packing, distribution and return
Pricing	Sets out in detail how prices are to be provided, terms of payment and sanctions for non-performance

3.400   The specifications for this activity can be used as the basis for a contract, whether it is a commercial arrangement or one with another government agency. Even though another government agency may be used, it is important that a formal agreement along the lines outlined in sections D.4 and D.5 below still be used. Some elements of the agreement may not need to be included, but it is important that both agencies clearly understand, and agree on, the requirements for this major activity.

3.401   In either case, the specification may include some or all of the following items; however, there may be additional items required, depending on the circumstances of the country involved, especially if digital devices are used for field enumeration.

4.   Estimating quantities

3.402   Estimating quantities not only establishes the volume of materials to be packed and transported but also provides a key input into the printing or purchase process (that is, the number of each item that needs to be printed or the number of devices that must be purchased). A lack of material or devices during enumeration can have serious consequences, as there will not be enough time to print or easily obtain additional quantities. However, a cost-effective census requires that there are no excessive amounts of material. Estimates should also provide for a reasonable level of contingency.

3.403   The basis for estimating quantities is to establish the number of items each person in the field hierarchy requires to complete their tasks. These items can then be multiplied by the number of staff in each level of the structure. This gives the standard pack sizes referred to below.

3.404   The number of items each person requires is usually based on the amount of work to be done (that is, the number of dwellings to be enumerated), plus a reserve factor. This is based on the number of items to be used by each enumerator, supervisor and so forth. For example, to enumerate 100 households, the following items might be provided to an enumerator: 110 census questionnaires, 110 information brochures, 50 calling cards, 5 objection report forms, 1 satchel, 1 clipboard, 2 pencils, 1 pencil sharpener, 1 identification card and other materials such as envelopes. In the case of a digital census, each enumerator should be assigned a handheld device. A supervisor may receive a handheld device and, if necessary, a laptop computer. Fieldworkers may require some paper items, such as calling cards and objection report forms, even if data collection is digitized.

3.405   The above example shows that some spare census forms are provided. This is necessary in case the enumerator needs to use an additional form at a dwelling or finds additional dwellings in the enumeration area. Assuming that all enumerators will have a workload of 100 households, the quantities in the above list are multiplied by the number of enumerators to establish how many forms will be required in total. However, it is unlikely that all enumerators will have workloads of exactly the same size. Therefore, it is necessary to make some judgement, perhaps based on information from the mapping activity, about what is an average workload size.

3.406   During the design of enumeration areas and mapping tasks, an estimate will be made of the number of enumeration areas, and the amount of work in each. This information can be used to calculate how much material will be needed by each enumerator, supervisor and so on. This method should provide a more accurate forecast of needs.

3.407   For simple items (such as calling cards), the cost of printing additional quantities may be minimal; thus, estimates can be rounded up with little impact on the overall cost. For more complex items (such as the enumerator's manual or handbook), the cost of printing will be more significant, and care should be taken with final calculations.

3.408   As with the printing operation, the use of a spreadsheet (either computer based or clerical) can assist with estimating quantities. An example of how a spreadsheet might be used to record the basis of estimates and total quantities is given below. The first group of factors would be recorded in a separate sheet and used as multipliers in a second sheet containing a list of items, as follows.

3.409   factors:

(a) Number of enumeration areas;

(b) Number of enumerators (if not the same as (a) above);

(c) Number of supervisors;

(d) Number of regional managers (deputy regional managers).

3.410   The following variables would be recorded for each item to be provided and multiplied by the relevant factor above:

1. Item
2. Number per enumeration area
3. Total required for enumeration areas ((a) x 2)
4. Number per enumerator
5. Total required for enumerators ((b) x 4)
6. Number per supervisor
7. Total required for supervisors ((c) x 6)
8. Number per regional manager (deputy regional manager)
9. Total required for regional manager (deputy regional manager) ((d) x 8)
10. Subtotal required (3 + 5 + 7 + 9)
11. Reserve factor (10 x per cent) where per cent is judged on an item-by-item basis
12. Total requirement (10 + 11).

3.411   In this model, items may not be required by all levels and accordingly would simply be shown as a nil requirement, and thus would not add to the total. For example, enumerators would not require application forms for supervisor positions. However, regional managers may receive a small reserve of census questionnaires or simply a few as samples for their own use.[54]

3.412   The primary benefit of using a spreadsheet is that assumptions about supply can be varied and quantities recalculated quickly. For example, the initial calculation may be for two copies of the objection report form in each enumeration area, but this may be considered too

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[54] In certain circumstances, there needs to be additional provision to mitigate a shortage of census forms in a particular region, whether due to recent building construction or other factors. In the case of India, a 10 per cent allocation of reserve forms is available in each region.

low and a decision made to supply a pad of 10 forms to each enumerator. This could be easily remodelled in a spreadsheet.

5.   Packing

3.413   The movement of the bulk of the material associated with field operations is best carried out by way of modular cardboard boxes. The shape and size of the boxes should be designed around the size of the census questionnaire or handheld collection devices, taking note of the occupational health and safety requirements for handling heavy or delicate equipment. The same cardboard boxes can also be used for transporting administrative and training material.

3.414   Within these boxes, the census forms themselves can also be packed into bundles of forms (for example, lots of 50 forms) that are shrink-wrapped in plastic. This has the advantage of protecting the forms and making it easier for supervisors to count and distribute forms to enumerators.

3.415   The boxes should be sealed to prevent tampering with the contents during transportation. One method to assist security is to transport two (sometimes three) boxes inside a larger one. The outer box would be designed for security, storage and transport.

3.416   In addition, it is very important to prevent the boxes from getting wet or damaged in the rain. This is especially true of paper questionnaires, where the data will be captured using a scanner. But it also holds true for digital devices.

3.417   Most of the transport arrangements put in place for field operations will be on a price per box basis. An outer box containing two boxes of census materials would be recognized as a single box for counting and charging purposes. However, this would not necessarily be the case if a price per kilogram basis were used.

3.418   It is desirable to design boxes for use in the field operations that can also be used to store and move the census questionnaires around the processing centres. The boxes, therefore, should be preprinted, with spaces for packing staff to identify the contents for enumeration staff and, subsequently, for enumeration staff to identify the contents for processing staff. Additional labelling for processing purposes can be included on the box when it is produced.

3.419   The content of the boxes will depend largely on how materials are to be supplied to supervisors and from there to enumerators. There are two methods: (a) bulk supply; and (b) pre-packing.

5.1   Bulk supply

3.420   Under this scenario, each supervisor is provided with a bulk supply of each of the required items for enumerators. The supervisor would then count out and repack the required items for each enumerator from the bulk supply received. Supervisors may also be supplied

with a number of standard census boxes (see above) into which to repack material for enumerators.

3.421   This method has the advantage of simplicity but also a number of disadvantages, including the following:

    (a) Reliance on supervisors to count and repack material;

    (b) Reliance on suitable packing by the original printer or supplier;

    (c) Larger number of boxes of different shapes and sizes (non-standard appearance);

    (d) Low likelihood of materials being clearly labelled as census material.

3.422   A key task for the census management area with this method is to ensure the coordinated supply of the different items through a transport staging area. Direct supply from printers to supervisors should be avoided from both a management and a quality perspective.

5.2   Pre-packing

3.423   In this instance, material is pre-packed centrally or in a small number of packing centres. It involves preparing packs of material suitable for use by enumerators and higher-level staff. One method of pre-packing is to make modular packs that are designed to contain all the materials required to enumerate a given number of households. With this method, the supervisor's job only requires them to calculate how many packs each enumerator will need, rather than counting and repacking materials for each enumerator. Another advantage of this method is that standard census boxes are used from the outset in a more controlled manner.

3.424   The content of the packs is determined in advance by the census agency and is based on the concept of uniform content wherever possible. This simplifies the packing process and is therefore likely to increase the efficiency and accuracy of supply delivery. Uniform content simply means that each pack type contains the same number of each item.

3.425   There may be several pack types. For example, there may be packs containing material to enumerate dwellings in urban areas, dwellings in rural areas, or people in special dwellings; or a pack may contain material for a supervisor to recruit and train enumerators.

3.426   The variation in pack types would depend on the basis of the enumeration, how feasible standard content packs are in relation to enumeration area sizes, and size of the country. The main advantages with this method are a standardized form of supply, less dependence on supervisors to count and repack, and a standardized appearance for census materials.

6.   Census agency management role

3.427   The role of the census agency with regard to dispatch and return tasks is primarily one of liaison and monitoring. For the most part, the contractor will contact regional managers and supervisors directly about the delivery or pickup of material. The census agency can

expect to be involved in liaison between the contractor and field staff during the early stages of the operation or when either group experiences problems.

3.428   The census agency management staff should meet frequently with the contractor to discuss the operation and liaison arrangements. These staff should also visit packing centres to become familiar with how the operation works.

3.429   Part of the planning of the operation will include arrangements to enable census agency management staff to monitor the delivery and return of materials. In particular, when material is picked up from supervisors, census agency management staff should maintain a close watch over what is taking place in the field as the transport of completed census forms is involved. Also, they should ensure the return of the blank questionnaires.

7.   Mail-out/mail-back census

3.430   There are a number of key issues to consider in relation to distribution and return tasks when conducting a mail-out/mail-back census. For the mail-out component, these include the following:

(a) A complete and accurate list of addresses of households for the entire country;

(b) The postal service infrastructure throughout the entire country;

(c) Cost of the exercise.

3.431   In the majority of countries, comprehensive lists of addresses are not available, which can result in underenumeration of a census.

3.432   Even in countries where most of the population is covered by an effective mail service and a mail-based operation is adopted as the standard procedure, there may be some regions that are unsuitable for a census mail-out/mail-back operation. Examples include remote rural areas or informal squatter camps. Alternative procedures will need to be adopted for such areas.

3.433   Because of the lack of comprehensive mailing lists, some countries have adopted a combination of delivering forms through an enumerator and the respondents mailing them back. The issues associated with the delivery of forms are discussed in the sections above. For the mail-back component to work efficiently, the postal infrastructure needs to be able to handle the volume of mail generated by such an operation within an acceptable period. A formal agreement between the statistical agency and the postal organization would need to be in place. Issues to consider with mail-back include the following:

(a) Form size;

(b) Weight;

(c) Cost per unit;

(d) Confidentiality and security of census forms.

3.434   Forms can be mailed back directly either to the processing centres or to the regional mail-back centres specifically established to receive initially the census forms mailed by respondents. In both cases, forms received will need to be reconciled with the enumerator's record book, and procedures will need to be in place to follow up non-responses soon after census day to ensure that people have not moved and to satisfy processing timetables.

3.435   Barcode identifiers on forms and enumerator's record books can be considered a basic tool for this reconciliation process. Alternatively, a complete list of dwellings, with their corresponding identification numbers for the census, residing within a central automated control system, could be used to automate the receipt of questionnaires and identifying non-responding dwellings for subsequent field follow-up.

3.436   In countries where self-enumeration using the Internet is implemented as a method, the statistical office needs to develop adequate procedures for making the provision of information by the respondents as clear as possible. One approach is to send regular mail with instructions on how to fill the census questionnaire online – an approach that, where applied,[55] has proved successful.

3.437   If lower-than-expected response rates are achieved in the mail-back process, there will have to be increased follow-up operations by enumerators. This will have a negative impact on both the census budget and the timetable.

8.   **Digital devices**

3.438   The use of handheld devices for field data collection is becoming more common for censuses where integrated systems are deployed for enumeration area delineation, house listing, enumeration and processing. These devices require some additional considerations for their safe distribution and return.

3.439   Electronic devices require handling and care beyond the considerations given to packed paper materials. The statistical agency may wish to consider a partnership with an in-country supplier or with a logistic company for their proper delivery to distribution centres throughout the country. Alternatively, the devices can be delivered to the central office and a cascading system can be used to distribute the devices, similar to the distribution of paper-only materials in a traditional census. In either case, each device should receive a barcode associated with the device's unique serial number. Each device should also be preassigned to the field member who will receive it. Staff may check the devices in and out by using a scanning system similar to those used in many libraries on a daily or weekly basis. Regardless of the exact system used, staff should sign a form indicating that they understand they are responsible for the proper use, care and return of the devices.

3.440   The return of paper questionnaires according to appropriate operational control procedures is required for data capture in a paper-based census. Data capture usually happens instantaneously through the cellular data network or via a hardwired connection on a rolling

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[55] As in Canada, for example.

(daily or weekly) basis in a digital censes. Thus, when enumeration and follow-up field operations are complete, the handheld devices no longer have an operational use for the census. However, they must be returned owing to their inherent value. A reverse cascading system, where supervisors collect devices from their direct subordinates, can be used to return the devices to the statistical agency.

3.441   Electronic devices also present additional logistic issues. Cases that can protect the devices from spills and minor falls can be included with materials delivered to field staff. The battery life of the devices must be considered against the maximum amount of time that an enumerator can expect to go without the opportunity to recharge. If the battery life is shorter than this period, for example in a remote or rural part of the country, provision must be made to recharge the device (using for example battery packs, car chargers, or generators at the local census office).

3.442   Procedures should also be put in place to ensure the security of the information stored on the devices, for example through the use of password protection and special applications meant to disable the devices if they are not reported back. Experience with the use of electronic devices in the 2010 census round points indicates that these devices should be (a) functional solely for data collection purposes, without other applications that might make them attractive for general use; (b) rugged to withstand diverse environmental conditions and elements of the weather, such as rain; and (c) aesthetically unpleasing, to reduce potential for theft.

IV. Field enumeration

A. Introduction

4.1   The field enumeration phase of the census marks the peak of census-related activity. However, success during the enumeration phase rests on proper planning and process development during the months and years before the enumeration period. Institutional memory within a statistical organization usually maintains a rich collection of experience and expertise on field operations. Enumeration operations are a core competency for national statistical organizations. However, changes in technology, primarily the move towards digital mobile data collection and Internet data collection, increasingly require updated policies and procedures during data collection. A key challenge for census managers will be to integrate their previous experiences in field data collection with the technology that has an impact on fieldwork and that is becoming increasingly available.

4.2   Previous chapters on planning the census and pre-enumeration operations have covered topics that have a direct impact on data collection during enumeration. The present chapter is limited to the topics directly related to carrying out the field enumeration and ensuring the collection of high-quality data. It covers the following topics:

   (a) Types, method and timing of enumeration

   (b) Role of supervisors and enumerators

   (c) Living quarters and household listing

   (d) Monitoring and management of field enumeration

   (e) Quality assurance for field enumeration

   (f) Type of technology for field enumeration

B. Enumeration

1. Introduction

4.3   Since individual enumeration is essential, the main objective of enumeration is to ensure that all individuals are covered and enumerated only once. For this purpose, clear descriptions of the place of enumeration and who will be included in or excluded from the enumeration are very critical for developing appropriate enumeration procedures in the field. Although general practice regarding the application of each type and method of enumeration might be similar across countries, the treatment of various population groups differs significantly, and sometimes there is no clear instruction for enumerating those people.

4.4   This section covers the topics that have to be taken into consideration for developing enumeration procedures, focusing on enumerating special population groups and possible procedures for enumerating these groups.

2. Place of enumeration

4.5   The place of enumeration would be either the place where the person is present or the place of usual residence of the person at the time of the census. There should be clear instructions for all possible cases that may create confusion for identification of the place of enumeration to ensure that every individual has only one place of enumeration.

2.1   *Place where the person is present*

4.6   All individuals who are present in a country at the time of the census are enumerated. With this approach, foreign residents who are present in the country at the time of the census are included but usual residents of the country who are absent at the time of the census are excluded from the enumeration. This type of enumeration removes complications associated with the application of various criteria for defining the place of usual residence. Simplicity in definition and not requiring additional criteria for enumerating the population in the field are the main advantages of this approach; on the other hand, the fact that the population present count derived from this enumeration may not provide a true geographical distribution of usual residents for effective planning is a major disadvantage.

4.7   People are enumerated either in the household or in the institutional places where they are present at the time of the census. Other places where there is a possibility of finding individuals, such as hospitals and hotels, can also be covered in the enumeration. Explicit instructions for the address coverage in which the enumeration will take place should be given to the field staff. Defining the addresses for temporary stay is a challenge for the field organization.

4.8   It is very useful to design the census questionnaire to collect information to identify the persons who are present but not at their usual residence, and those who are not usual residents of the country.

4.9   The procedures for enumerating people who may be travelling or away at work during the night preceding the census day must be specified. The practice generally adopted is to enumerate persons who may have been travelling throughout the night preceding census day at the place where they are found at a reasonably early hour on the morning of census day.

4.10   Enumeration staff located at railway and bus stations, ports, ferry terminals and airports will enumerate such persons at daybreak, after making sure that they have not been enumerated at an earlier travel stop. Persons at work on the night preceding census day are generally enumerated in the place where they would otherwise have slept but for having been away at work.

4.11   For mail-back or online-based self-enumeration, instructions should clearly specify who in the household should be enumerated and on which day or period.

2.2   *Place of usual residence*

4.12   All usual residents of a country at the time of the census are enumerated. With this type of enumeration, the citizens of a country who reside outside the country are excluded from the enumeration, while the foreigners who usually reside in a country are included in the enumeration.

4.13   For most individuals, it is not difficult to identify the place of usual residence. For others, however, application of this definition can lead to many interpretations, in particular if the person has moved often. For those people, a threshold of 12 months when considering the place of usual residence is recommended,[56] in the form of two options: (a) the place at which the persons has lived continuously for most of the 12 months or intends to live for at least 6 months; or (b) the place at which the person has lived continuously for at least 12 months or intended to live for at least 12 months.

4.14   There can be challenges in applying the concepts of a "usual resident" if a person is considered to have more than one place of residence within a country, sometimes in different countries. There may also be those who do not considered themselves to have a usual residence at all, such as nomadic peoples. The following suggestions are provided by the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, for improving international comparability for resolving the cases where the place of usual residence is not clear or whether it is in the country or abroad.

(a)   Identification of the place of usual residence for specific population groups

4.15   There are various population groups for which uncertainty may arise in defining their place of usual residence within the country. The recommended conventional treatment of these cases is as follows:[57]

(a) Persons who work away from home during the week and who return to the family home at weekends should consider the family home as their place of usual residence.

(b) Persons of minor age in primary and secondary education who are away from home during the school term should consider their family home as their place of usual residence.

(c) Students in tertiary education who are away from home while at college or university should consider their term-time address as their place of usual residence regardless of whether this is an institution (such as a boarding school) or a private residence.

(d) The institution should be taken as the place of usual residence of all inmates who at the time of the census have spent, or are likely to spend, six months or more in the relevant institution. Examples of inmates of institutions include patients in hospitals

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[56] See *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part two, chap. IV, sect. B.1.

[57] Ibid., part four, chap. I, sect. C.2.

or hospices, old persons in nursing homes or convalescent homes, prisoners and those in juvenile detention centres.

(e) Where a person regularly lives in more than one residence within the country during the year, the one where he or she spends the majority of the week or year before the census should be taken as his or her place of usual residence. These persons are not considered to be persons with no usual residence.

(f) For the (national) military, naval and diplomatic personnel and their families located outside the country the following classification rules should be applied:

  i.   If they are residing abroad for less than 12 months and they are intending to return to the place of departure, they should be allocated within the country in accordance with the rules for usual residence. In particular, they could be allocated to (by decreasing order of priority):

    –   The family home address within the country, if any;

    –   The duty station within the country to which they were attached before leaving.

  ii.   If they are residing abroad for at least 12 months or if they are not intending to return to the place of departure (although returning to the country within a 12-month period), they should be attributed to a "virtual region" (extra-region) of the country of departure.

(g) The place of enumeration should be taken as the place of usual residence of homeless or roofless persons, nomads, vagrants and persons with no concept of usual residence.

(h) A child who alternates between two households within the country (for instance after his or her parents have divorced) should consider the household where he or she spends the majority of the year before the census as his or her place of usual residence. Where an equal amount of time is spent in both households, the place of usual residence should be as for the household where the child is staying at the census reference time.

(b)   Persons who are included in the usual resident population

4.16   There are various population groups for which some uncertainty may arise about their inclusion in the usual resident population. The following persons would generally be considered in the usually resident population;[58]

(a) Persons found at the moment of enumeration that cannot identify their place of usual residence, such as those that move often;

(b) National military, naval and diplomatic personnel and their families, located outside the country;

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[58] Ibid., part two, chap. IV, sect. B.1, para. 2.53.

(c) Foreign persons working for international organizations (not including foreign diplomats or military forces), provided that they meet the criteria for usual residence in the country;

(d) Merchant seafarers and fishers usually resident in the country but at sea at the time of the census (including those who have no place of residence other than their quarters aboard ship);

(e) Persons who may be illegal, irregular or undocumented migrants, as well as asylum seekers and persons who have applied for or been granted refugee status or similar types of international protections, provided that they meet the criteria for usual residence in the country;

(f) Persons who cross a frontier daily or weekly to work or study in another country, provided that they meet the criteria for usual residence in the country;

(g) Children born in the 12 months before the census reference time and whose families are usually resident in the country at the census reference time;

(h) Persons of minor age studying abroad for one year or more to attain the primary or secondary level of education, regardless of the frequency of return to the family home located within the country. If the person is also working abroad, the same rules for cross-border workers apply;

(i) Persons who regularly live in more than one country during a year, if they are present in the country at the moment of the enumeration.

(c)   Persons who are excluded from the usual resident population

4.17   On the other hand, the following group of persons need to be considered for being excluded from the usual resident population:

(a) Foreign military, naval and diplomatic personnel and their families, located in the country, regardless of their place of usual residence;

(b) Persons of minor age attending the primary or secondary level of education whose family home is located abroad, regardless of the duration of their stay. However, if these persons are also working in the country, then the identification of the place of usual residence follows the same rules as for cross-border workers;

(c) Third-level students who are absent from the country for one year or more;

(d) Persons who regularly live in more than one country during a year, if they are not present in the country at the moment of the enumeration.

2.3   Obtaining both the place where person is present and the place of usual residence

4.18   If obtaining both populations is desired, the questionnaire will have to distinguish between the following persons with reference to census day:

(a) Usually resident and present;

(b) Usually resident but temporarily absent;

(c) Not usually resident but temporarily present (visitors).

4.19   Information will also have to be obtained about the usual residence of those who are only temporarily present at the place (address) where they are found for coding to their place of usual residence. The collection of such complete information, especially if an interviewer method is used, has implications for the workload placed on the enumerators and supervisors.

4.20   Special care should be taken if both the place where the person is present and the place of usual residence are obtained, otherwise potential problems with double counting may occur.

4.21   If a self-enumeration method is used, particular care should be taken in conveying the concept to both the enumerators and the public. The possibility of collecting such complete information will have to be a matter of judgement for each country.

4.22   The general practice has been to adopt either of the two enumeration methods, with some variations. The enumeration method may be modified from the models described above to reduce conceptual problems for the enumerator and the public. For example, when an entire household is away from its usual residence during the enumeration period, some provision can be made for collecting information about such persons at the place where they are found at the time of the census. To deal with such variations, careful instructions and adequate training are required.

4.23   Care should also be taken that people in these situations are enumerated consistently in order to avoid some being treated one way and others in a different way. This could give rise to inequities in distribution of resources, as may occur, for example, if students in one area are recorded as being residents of that area, whereas students in another area are recorded against their parents' addresses.

3.   Method of enumeration

4.24   There are two major methods of enumeration: face-to-face enumeration and self-enumeration. A combination of these two methods can be applied in the same enumeration. However, the application procedures for each method in the field vary from one country to another. In addition, the use of new technology for either of these methods can result in many variations of application of the methods in the field.

4.25   This section presents general information about the procedures for applying each type of method of enumeration and the potential benefits and limitations of each method.

3.1   Face-to-face or interview method

4.26   In the face-to-face method, the questionnaires, whether on paper or in electronic format, are completed by an enumerator who conducts necessary field enquiries, usually by interview, about each housing unit and about each person. The enumerator then records the

information on the census questionnaire. Owing to cost and time constraints, a representative adult member of each household usually reports for all members of the household.[59]

4.27   The records are always in the possession of the enumerator and are not handed over to the household.

4.28   This method has been adopted in most developing countries. It has the following advantages:

(a) Enumerators can be well trained in the concepts, instructions and procedures.

(b) If there are sufficient numbers of enumerators and supervisors, the enumeration can be completed in a short time.

(c) In areas of relatively low literacy, the meaning and purpose of the census questions can be better conveyed to the people by oral communication rather than through printed material. Such direct interviews by the enumerators elicit prompt replies, and cases of reluctance to cooperate can generally be settled during the course of the enumeration itself.

(d) Within an enumeration area, the information is likely to have fairly uniform quality and consistency.

(e) More complex questions can be included in the census than would otherwise be possible.

4.29   The census questionnaire used with the face-to-face method can be either paper based or electronic, using such portable devices as laptops or tablets.

(a)   Paper questionnaire

4.30   The traditional method of enumeration is the interviewer method with paper forms. The paper questionnaire can be designed for data capture through manual entry or optical scanning. Many countries use optical scanning to achieve fast and accurate data processing.

(b)   Electronic questionnaire

4.31   As the technology for mobile electronic devices such as tablet PCs and smartphones has become more widely available, the use of an electronic questionnaire with computer-assisted personal interview (CAPI) is becoming more common. In the CAPI methodology, enumerators use laptops, tablets, smartphones or other handheld electronic devices to conduct interviews. The enumerators directly enter the responses on the digital questionnaire.

3.2   Self-enumeration method

4.32   Most developed countries have adopted the self-enumeration method. In this method, the information about the housing unit and the members of the household is recorded on the

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[59] However, practices differ by country. In Germany, for example, interviews have, by rule, to be conducted with every single person in the household over the age of 16.

questionnaire by one or more members of the household. The questionnaires, along with the instructions, are distributed to every household in advance of the census date and received back after completion.

4.33　The identification and location particulars of the household are generally recorded on the questionnaires prior to being handed over to the household. This method can be adopted, with the expectation of reliable results, at substantially lower costs than the interviewer method, in countries where:

(a) Literacy is near universal;

(b) Educational levels are relatively high;

(c) Communication systems are widespread and efficient;

(d) Up-to-date address or population registers exist (countries are increasingly using administrative data to improve their mailing list for self-enumeration).

4.34　The self-enumeration method is also conducive to greater involvement of other members of the household in the enumeration process. This is because it encourages consultations among family members, which should yield more accurate and comprehensive information regarding the individual members of a household.

4.35　The forms can be distributed and collected by enumerators, by mail, by telephone or electronically through the Internet. Use of several methods in one operation is very common for the self-enumeration method.

(a)　Enumerator distribution and collection

4.36　The questionnaires can be distributed to the households by the enumerator personally and collected after a fixed period of time. The enumerator may merely act as the agent for distribution and collection or, depending on the circumstances in each country, may also assist in completing the forms.

4.37　In some cases, the questionnaires and the instructions are handed over to the households by the enumerator, with a request that they be completed and kept ready for verification. The enumerator will, in a second round, collect the forms, verify the entries and correct them, if necessary, through personal enquiries. In some countries the verification process is rigorous, while in others the forms are only scanned to ensure that complete pages have not been omitted by accident.

(b)　Mail-out/mail-back system

4.38　In some cases, the forms are mailed to households on the basis of mailing lists and received back through the mail. In this mail-out/mail-back procedure, the role of the enumerator is limited. However, there will be cases of non-response or incomplete response, in which case the enumerator may have to intervene to obtain full information. Such gaps could also be filled through telephone enquiries, where the facilities are efficient and widely

available. The communication and publicity strategy (see chap. II, sect. H) will also play a significant role in providing explanatory material to the respondents.

4.39   Countries that have used mail-out/mail-back methods have indicated that significant savings can accrue if the postal and address register systems for mail-out are adequate. However, the preparation and maintenance of such a mail directory is difficult and expensive. Some countries use administrative data, such as tax records and public pension system records, to improve the accuracy of the mail directory.

4.40   A method that involves a mail-back approach has the particular disadvantage of census materials being beyond the control of the statistical agency for a key part of the operation. This highlights the importance of some issues, including the following:

(a) Determining delivery strategies, which must be considered carefully in the initial planning phase;

(b) How to monitor effectively which households have mailed back their census forms;

(c) The relationship with and reliability of the country's postal services;

(d) Problems with non-response rates in particular areas.

4.41   The problems with non-response rates in particular areas can be dealt with by using interviewers to follow up on non-responding households. Interviewers may visit households that have not returned their questionnaires to conduct interviews or they may interview them by telephone.

4.42   If there is a low response rate to the mail-back operation, the costs of following up all non-respondents could be very high. These costs may be contained by adopting direct sampling methods for those households that do not respond. An important point to observe in adopting such a practice is that all non-responding households must have a known probability of selection in the sample. Also, the follow-up must be intensive to ensure that all selected households provide a completed questionnaire.

4.43   A wide range of possible sampling plans could be envisaged, and it is beyond the scope of the present manual to consider them in detail. The key elements of the plan are that: (a) it must provide data of the standard required by clients of the census programme; and (b) the rules and procedures for selecting the sampled units must be easy to apply, since this aspect of the collection will, in most cases, also be undertaken by temporary staff.

4.44   For example, it may be decided that a 90 per cent response rate for all geographical areas is required. Those geographical areas with response rates of, for example, 70 per cent can have the balance of the households sampled at a rate of 2 in 3 to achieve the necessary 90 per cent response rate. Geographical areas with initial mail response rates of better than 90 per cent could have the balance of households sampled at 1 in 10. This is because there may be a difference between those households that responded and those that did not.

(c)   Internet or email

4.45   The Internet is another way to distribute and collect census questionnaires. This method of self-enumeration is generally offered as one of many options in a multimodal census. A notification about the census is sent out in advance either by mail or email with instructions on how to complete the census questionnaire on a website. The advantage of this method is that it is cost-effective. The disadvantages are similar to the mail-out/mail-in method: determining the delivery method, how to monitor which households have completed the census questionnaire, availability of Internet in the country, and non-response rates with particular populations. In addition, data security concerns over the Internet demand sophisticated solutions.

4.46   Countries that choose to use a paper or Internet self-enumeration method as their primary mode of data collection may choose to supplement this with a telephone completion service. Such a service is of particular use to respondents who have difficulty in completing the questionnaire without assistance, for example because of poor eyesight.

(d)   Telephone

4.47   Another method of distribution is the telephone. A telephone number is provided to people with instructions on how the process will work. Then, they can call – free of charge – a number where they will speak with a computer-assisted telephone interview (CATI) representative. This method is generally used for non-response follow-up purposes.

3.3   Combined methods

4.48   A combination of both face-to-face and self-enumeration methods is often used for the purpose of ensuring maximum coverage. In these cases, the self-enumeration method is adopted in areas where the response rate is likely to be high, while the face-to-face method is used in areas, or community situations, where the literacy levels are low or special problems exist. In areas where the mailing system may be ineffective or too expensive or where the terrain or climatic conditions impose constraints, the face-to-face method is adopted as being more conducive to high-quality enumeration.

4.49   Combining different methods is not limited to the example above. Censuses can use different combinations, such as the use of population registers combined with surveys, or the full enumeration of housing units with a population survey. However, the emphasis in the contemporary technological and living environment is increasingly on a combination of the use of portable, mobile devices for field enumeration and self-enumeration using the Internet.

4.50   Furthermore, administrative data are increasingly being used in combination with face-to-face and self-enumeration methods to improve master address lists to increase self-response rates.[60]

3.4   Other methods

4.51   Some countries have applied other methods of enumeration for specific areas or population groups in which regular procedures of face-to-face or self-enumeration methods cannot be applied. The followings are some examples.

4.52   All households may be listed in a preliminary round and a census station is then established in the enumeration area. Respondents are requested to gather at the census station in order to give the enumerator detailed information on each topic. In this method, the enumerator does not visit every household for the purpose of completing the forms. The preliminary listing of households enables the enumerator to keep track of non-reporting households and ensure complete coverage. However, even with the adoption of this procedure, it will still be necessary for the enumerator to visit some households. This will occur in cases such as those where, owing to illness or physical incapacity, no member of the household is able to report to the enumeration station.

4.53   The inhabitants of a village or people living in dispersed settlements may be assembled at one place and enumeration carried out. In some cases, the head of the group provides the information regarding its members. In the group approach, abbreviated questionnaires are generally used. The objective in such cases is to obtain, as a priority, reliable estimates of numbers rather than highly detailed information relating to every member of the group. The drawback of such a group approach is that people may not give full and frank answers to some questions. With improvements in communications and accessibility, and with the integration of previously isolated or special groups in the larger community, the adoption of the interviewer method should be increasingly possible in such cases.

4.54   A similar approach may also be adopted, formally or informally, where a community group, such as recent immigrants, has relatively limited skills in the official language of the country. This approach can make effective use of limited interpreter resources or utilize the official language abilities acquired by school attendance of relatively young members of the immigrant group.

4.55   In recent censuses, with privacy awareness of the census increasing, there have been demands for separate personal enumeration. Those demands are still rare, but some countries allow persons to be enumerated separately. The linkages with the household and the housing unit are maintained through the use of relevant identification codes. The questionnaire is

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[60] Detailed discussion and elaboration on census methodology and the combination of different methods is presented in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part one, chap. IV.

devised so that it can be sealed and either posted or handed over to the enumerator. The adoption of this procedure would imply that arrangements have been made for early checking of such returns and amendments through personal contact, if necessary. A reduction in the numbers of such returns can be attempted by supervisors in difficult cases through personal contacts.

3.5   *Changes in enumeration method*

4.56   Most countries have tended to retain the method of enumeration[61] they used in previous censuses. Any strategic change in the method requires careful testing and evaluation before it is introduced. Changing the enumeration method generally refers to switching from face-to-face interview to self-enumeration, and such a change could, if not properly implemented, have an adverse impact on the coverage and quality of the census, requiring careful consideration and testing before implementation. Examination and testing of possible improvements in census processes can be profitably undertaken during the intercensal period, taking advantage of the experience in other countries.

4.   Population groups difficult to enumerate

4.57   In general, the majority of the population can be enumerated through general procedures involving face-to-face or self-enumeration methods, as explained in the previous sections of the present chapter. However, in every country, there are specific population groups for whom alternative arrangements are necessary in order to count them effectively. For these groups, special enumeration procedures need to be adopted. Developing special enumeration procedures is a complex process, because different measures are needed for different types of population groups. There might be many diverse groups that have to be considered when developing these procedures. In general, challenges can be grouped into two broad categories: (a) challenges focusing on particular subgroups of the population; and (b) challenges related to the type of environment in which the people live.[62]

4.1   *Subgroups of the population*

4.58   **People with limited understanding of the language of enumeration.** Not all respondents will speak or understand the language or languages in which the census is being conducted. Therefore, consideration and thought needs to be given to translation services and materials, especially with regard to understanding the types and concentrations of languages required.

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[61] In this context, the method of enumeration differs from the main census method, which primarily refers to the manner in which census statistics are sourced: whether the information is collected by approaching each household in the country or whether the source of census statistics is an administrative one (such as population registers or a combination of registers).

[62] See *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part three, chap. VII, and part four, chap. II.

4.59   **Migrants.** Recent migrants to the country may be unfamiliar with the language or may be unfamiliar with the census and the reasons for collecting the information. Therefore, as part of developing the enumeration, design consideration needs to be given to communicating with these groups, in particular about the benefits of the census, in order to ensure that they understand the need for the census and are more likely to respond during enumeration.

4.60   **Students.** Students can pose a risk to the quality of the enumeration, as they tend to be large in numbers and highly concentrated around universities or other institutions for post-secondary education. Therefore some consideration should be given as to whether they require slightly different, more specific methods (in particular if they live in large living quarters) or tailored communication to ensure they understand the benefits of completing a census questionnaire.

4.61   **Elderly.** Particular assistance may be required for the elderly population, where some of the census elements (such as "age") may present difficulties of recall. Depending on the circumstances, additional materials may be required (such as a calendar of events to help to remember or estimate their age) or specific activities to provide assistance in completing a questionnaire or interview through the engagement of supporters (such as family members, village elders or residential home staff).

4.62   **Undocumented migrants.** Unless a specific and targeted census promotion campaign is launched, the reluctance of undocumented migrants in the country to engage in the census will inevitably lead to lack of cooperation with the enumeration. Public assurances should be made that data collection will have no consequences whatsoever for the respondents.

4.63   **Stateless persons.** These are individuals who are not considered as nationals by any State under the operation of its laws. They are often undocumented and may not wish to be enumerated. However, every effort should be made to include such persons in the census. The census office should work with responsible government agencies and other organizations familiar with this population group to establish the best method for identifying stateless persons and collecting census information from them. Country of citizenship is generally essential for the identification of this group. The census office should consult with relevant ministries and agencies, including the Office of the United Nations High Commissioner for Refugees, to determine whether additional information (such as residence history or identity documentation) may be required to establish the status of a stateless person.

4.64   **Enumeration of the defence forces and persons in restricted areas.** The procedures for the enumeration of the defence forces and the presentation of data for this group are matters that need special attention when planning the enumeration. In some countries, defence personnel are enumerated but the results are aggregated in such a way that these personnel cannot be identified from the published data. In particular, most countries present the data in a form that prevents the identification and location of defence camps and concentrations of troops. This is often a matter of State policy and security.

4.65   Appropriate enumeration and tabulation procedures will have to be developed for this purpose by each country. It is beyond the scope of the present manual to specify the full range of possible procedures. However, the probability of identifying current locations of forces is reduced under a usual residence census. This will require careful management of the actual enumeration task to ensure that people are able to report their usual residence when enumerated in barracks or defence camps. Caution should also be exercised to avoid the risk of double counting defence personnel in a usual residence census.

4.2   People living in a specific environment

4.66   **Nomads and persons living in areas to which access is difficult.** Making contact with these groups to enumerate them can be challenging, in particular as part of a point-in-time count. Enumeration may need to be done at a different time or over an extended period, or by using alternative methods to enable contact with these groups. For example, countries might consider asking those who provide services to these groups to assist with their enumeration. Seasonal movements may be identified in advance and this information can be used by collectors to enable contact. Planning and consultation are needed, in particular with influential members of these groups, prior to the census in order to make arrangements for their enumeration. Distributing communications that publicize the benefits of the census, and engaging appropriate leaders in support of the census, may assist coverage. Awareness of cultural issues relevant to specific groups should also be considered in developing enumeration strategies. Every care should be taken to avoid any duplication in the enumeration of nomads.

4.67   **Homeless or roofless persons, vagrants and persons with no concept of usual residence.** These should be included in the population count, and the census office should work with local government agencies, charities and other supporting bodies that provide support for these population groups to identify the localities of their resting places and report the same to the enumerator in charge for coverage during the last enumeration night, so that their coverage can be ensured and duplication can be avoided.

4.68   **Rural populations.** Understanding the extent of rural populations, and the logistic and management challenges associated with running a collection exercise in rural areas, needs careful consideration.

4.69   **Civilian residents temporarily absent from the country.** As these persons will be absent from the country at the time of the census, they will be excluded from a population present count. To produce a usually resident count, countries may collect information on these people from another family or household member present at the time of the census, but where a complete family or household is outside the country at the time of the census, it may not be possible for the census to collect information about these people. Estimates for usual residents temporarily absent from the country based on other sources may be required to produce reliable estimates of usual residents for planning and policy purposes.

4.70   **Civilian foreigners who do not cross a frontier daily and are in the country temporarily.** This category includes undocumented persons and transients on ships in harbour at the time of the census. These groups may be in the country at the time of the census and therefore they are part of the population present count. It is important to include these groups in the population count if their demand for services is to be considered for planning and policy development purposes. However, these groups may prefer not be counted, either because they fear ramifications from being counted or they do not identify themselves as part of the population of the country. Language and communication may present challenges. Countries need to develop strategies, appropriate to their context, to include these groups in their enumeration.

4.71   **Refugees, asylum seekers and internally displaced persons.** Refugee populations, asylum seekers and internally displaced persons (inside and outside camps) should be enumerated and their numbers presented separately, allowing calculation of country population excluding such groups, when such a population count is required for non-demographic purposes.

4.72   **Military, naval and diplomatic personnel.** This category will include military, naval and diplomatic personnel and their families located outside the country, and foreign military, naval and diplomatic personnel and their families located in the country. Apart from the difficulties mentioned above that are common to groups who are absent from their own country, enumeration of these groups is subject to diplomatic protocols. Detailed counts and characteristics of these groups may be considered sensitive on security grounds in some countries. Counts of these groups may be available from administrative records.

4.73   **Merchant seafarers and fishers resident in the country but at sea at the time of the census.** These will include those who have no place of residence other than their quarters aboard ship. Identifying that the ship will be at sea at the time of the census may be problematic, so countries will need to develop strategies to ensure inclusion of this group in the population count. This may include providing the group with census forms before their ship goes to sea or enumerating the ship before the time of the census.

4.74   **Civilian foreigners who cross a frontier daily to work in the country.** This group should be excluded from a usual resident population count. The practice of counting people where they spend census night removes much ambiguity and reduces possible duplication. The difficulty then is trying to include them in a service population if countries want to consider this group in policy development and in planning service delivery.

4.75   **Civilian residents who cross a frontier daily to work in another country.** These persons are usual residents of the country and should be included in the population count.

4.76   **Persons living in buildings with restricted access.** Some properties, establishments, communities or compounds have controlled access, making it difficult to gain an interview or deliver or follow-up on a questionnaire. Access control mechanisms may include locked gates with an intercom to each individual dwelling or gates and doors managed by a concierge or security guards. When developing enumeration procedures, advice needs to be

given as to how to gain access and actions to take if access proves difficult. Some of the activities may include building a relationship with the owner of the properties to ease access and engage with residents; using the postal service to deliver questionnaires to these properties; or additional communication methods (such as a letter informing residents about the census and how to complete their questionnaire or inviting them to arrange a particular time to complete their questionnaire via interview).

5.   Timing and duration of enumeration

5.1   Timing of enumeration

4.77   The time of year during which the census enumeration will be conducted is an important planning factor. Some of the main issues that will determine the best time of the year for the enumeration include the following:

(a) **Time of year.** It is desirable to select that period of the year, taking account of the amount of daylight, during which the enumeration can be carried out simultaneously in all parts of the country, during which it is likely to yield the most typical data, and during which operational problems will be least.

(b) **Operational issues.** Consider weather conditions that may hamper field operations or call for a large mobilization of surface or water transport vehicles. The mustering of such input may not always be possible or affordable. The safety, retrieval, transport and storage of census field records immediately after the census enumeration are important considerations.

(c) **Seasonal conditions.** Extreme heat or severe cold will present risks to the enumerators, while heavy rain or snow may make some areas inaccessible. In countries with sharply contrasting seasonal patterns in different geographical regions, the most suitable period of the year for the major part of the country could be selected. Additional input of transport, staff or other requirements owing to adverse weather conditions in the specified areas can then be allocated. Sometimes, such considerations may compel separate enumeration of the nomadic population and populations in inaccessible areas.

(d) **Expected change with the seasons.** In some countries, the activities of large proportions of the population differ markedly between seasons. For example, agricultural workers may have a peak period of activity only during the agricultural season or at harvesting time. In such cases, it is unlikely that the affected part of the population will be able to devote the time needed to complete census forms. The decision as to how these activities can be reflected in a census can also be influenced by the design of reference periods for specific questions, and is a matter for each country to consider.

(e) **Demographic and social factors.** These will also be relevant if there are large migratory movements of the population during certain periods of the year (for example, when undertaking harvest activities).

(f) **Special occasions.** Periods of long holiday festivities, pilgrimages or fasting should be avoided.

(g) **Availability of personnel for the field force.** In many countries, officials such as schoolteachers are employed as enumerators or supervisors. The period of the year chosen for the census should therefore be when these staff are available and will experience the least disruption to their usual work.

5.2 Census reference time

4.78 Having determined the time of year in which the census should be taken, it is necessary to refine the timing of the census to a specific point in time.

4.79 An essential feature of a census is that each person, or each set of living quarters, is enumerated with reference to the same predetermined point in time. This census reference time is usually midnight at the beginning of the designated census day.

4.80 Each person alive at the census reference time is included in the count. People who die after this reference time are included, while people born after this time are excluded.

4.81 All structures, housing units or sets of living quarters that exist or have reached a defined stage of completion as at the census reference time are included in the housing census, irrespective of whether they are occupied. This arrangement will give a true inventory of housing stock. If the housing census is independent of the population census, an appropriate reference time will have to be specified for the housing census.

4.82 The concept of the census reference time is relevant for certain characteristics of the population, such as age, marital status and place of enumeration. Not all characteristics are defined in terms of such a specific point in time. Information on many census topics is elicited on the basis of other periods of time. For example, labour force status is usually based on a longer time frame.

4.83 In actual practice, enumeration may begin before or after the census day. If before, the forms are either distributed or interviews conducted over a short period before census day and collected or updated in a short round after census day. If after census day, the forms are distributed and collected or interviews conducted over a few days following the census reference time. In either case, the information collected will refer to the situation at census reference time.

4.84 Some countries have adopted a moving census day, such as the night before the enumerator's visit or the Sunday prior to that visit. This procedure is not recommended, although it has been adopted where problems force the extension of the enumeration period over a period of a month or longer. Such problems could include:

(a) Insufficient field staff;

(b) An unsatisfactory map base;

(c) Absence of sufficient logistic support.

4.85   The rationale for adopting a moving census day is that the respondents will not be able to recall details of the number, and characteristics, of the members of their households on a day significantly before the enumerator's visit. Therefore, census day has to be moved nearer to the day of the visit. The adoption of this procedure involving a long reference period, while preferable to no census at all, will increase coverage error and make the interpretation of the data more difficult.

4.86   If experience has shown that a particular census day or date has been found convenient and conducive to a good census, succeeding censuses should preferably be conducted with the same reference date. Unless there are strong reasons to depart from this practice, the timing of every census at the same time of the year would be desirable. A regular census date enhances the comparability of the data and facilitates analysis. The tradition of a fixed census date in a country also provides administrative discipline, motivating all those involved in the census to make necessary preparations in a timely manner.

5.3   Duration of enumeration

4.87   The actual duration of the enumeration period must be carefully considered and the advantages and disadvantages of each option compared. However, it is worth noting that a census is not an exact science, and whatever the duration adopted, there will need to be some trade-off between practical application of the census in the field and data quality. Such trade-offs need to be balanced in the best interests of the most efficient and effective census.

4.88   The duration of the census enumeration will be determined by the magnitude of the census operations, the availability of staff, logistic support and the method of enumeration. In principle, the enumeration period should be as short as possible.

4.89   In the face-to-face interview method, the duration should allow enough time for enumerators to complete the questionnaires in their workload without being rushed. If the time provided for interviewing is insufficient, the coverage and quality of enumeration will suffer. Conversely, a period that is too long may reduce the quality of the census, since respondents will have problems with recalling numbers of persons, or details of individual characteristics, with accuracy. In particular, extended periods of enumeration may result in incorrect reporting of numbers.

4.90   In a census that relies on self-response, if the period between the delivery of the forms and the time for collection or return is too long, there is a risk that the forms will become lost in the household or, at best, overlooked. Further, having too long a response period could result in inaccurate information being provided owing to problems of recall.

(a) One-day enumeration period

4.91   A few countries plan their enumeration so that it is conducted in a single day. A one-day enumeration is usually achieved by all persons staying at their residence on the chosen census day. However, apart from the several disadvantages listed below, such enumeration sometimes results in heavy-handed curfew measures that may negatively affect responses.

4.92   The adoption of the one-day procedure avoids the complexities that may arise owing to movement of people during an extended enumeration period. However, it has several disadvantages, as follows.

(a) A large number of enumerators are required for completion of the enumeration in all areas simultaneously in one day. The enumerators will have less opportunity to become proficient, as compared with a longer period of enumeration. This is because they are operating at the start of a learning curve.

(b) In terms of budgetary efficiency, a higher proportion of expenditure is attributable to overheads (recruitment, training) than to actual enumeration.

(c) The supervision of fieldwork may be superficial.

(d) There are likely to be more coverage errors, especially in urban areas where the optimum workload for a day cannot be predetermined accurately.

(e) To fit in with the shortened time period the content of the census will have to be restricted in comparison with what could be achieved with a longer period. The choice of topics and the degree to which information on those topics can be collected will be limited.

4.93   In actual practice, a census with a one-day enumeration period is accomplished by distributing the forms in advance for initial completion, or interviews are conducted by the enumerators before census day and then verified and updated on the census day. This may overcome many of the disadvantages listed above.

(b) Longer enumeration period

4.94   The adoption of a reasonably long period of enumeration would permit the use of a smaller number of better-trained enumerators. Also, the scope of the census could be expanded and, as a consequence, its utility enhanced. The enumerators would improve their skills after the start of the enumeration and supervision could be organized in a more effective manner. The enquiry could be conducted at a reasonable pace so as to ensure both accuracy of coverage and quality of information. However, if the enumeration period is too long, the defects in coverage and quality mentioned earlier might emerge.

(c) Rolling census

4.95   A rolling census refers to a type of census whereby data are collected by a continuous cumulative survey covering the whole country over an extended period of time (years) rather than on a particular day or during a short period of enumeration. The two main parameters of

a rolling census are the length of the period of enumeration (which is linked to the frequency of updates required) and the sampling rate (which depends on the geographical levels required for dissemination purposes). France is an example of a country that is conducting a rolling census based on a five-year cycle (box 26). Implementation of a rolling census requires complex sampling and modelling techniques.[63]

Box 26. French rolling census

The notion of a moving average over five consecutive years is applied for the rolling census introduced in France in 2004. Small municipalities (fewer than 10,000 inhabitants) are divided into five groups, and a full census is conducted each year in one of the groups. In all large municipalities, a sample survey covering 8 per cent of dwellings is conducted each year. After five consecutive years, the entire population in small municipalities and about 40 per cent of the population in large municipalities has been surveyed. In all, about 70 per cent of the French population is covered in the course of the five-year cycle. This is enough to guarantee robust information at the municipality and neighbourhood levels. The census results are based on moving averages calculated over the five-year cycle, and are updated yearly. This method was developed mainly to improve the frequency of data releases, and to spread over time the financial and human burden associated with the census.

Source: Paolo Valente, "Census taking in Europe: how are populations counted in 2010?" *Population and Societies* No. 467, May 2010 (ISSN 0184 77 83).

5.4   Critical dates

4.96   Some enumeration-related activities have critical dates or deadlines. The most obvious example is the census date itself. If procedures are not in place and field staff employed and trained in sufficient time, the census date will be missed, with potentially disastrous results. As the census date is the most important critical date, all other critical dates must be considered in relation to it.

4.97   Critical dates should be regarded as immovable. That is, if a date is to be considered critical, it should not be changed or allowed to be changed without serious consideration by the executive management of the census.

4.98   Early planning should establish the critical dates that will apply to the census enumeration phase. Some factors external to, or beyond the direct influence of, the statistical agency should be taken into account when establishing critical dates for census enumeration. Dates for the following key milestones may be considered critical dates. These will vary from country to country depending on the type of enumeration.

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[63] A discussion of necessary conditions, advantages and disadvantages, and implications of the rolling census is presented in *Conference of European Statisticians Recommendations for the 2020 Censuses of Population and Housing* (ECE/CES/41), Economic Commission for Europe, 2015, paras. 95–101.

(a) Government approval for the census, which is necessary to enable other activities to commence, such as printing the questionnaire;

(b) Completion of questionnaire design to ensure that printing can begin on time;

(c) Start and completion dates of questionnaire printing;

(d) Recruitment of field staff in sufficient time to allow training to be completed before enumeration starts;

(e) Training of field staff before enumeration begins;

(f) Start of enumeration;

(g) Completion of enumeration.

6.   Role of enumerators and supervisors

4.99   Canvassing the whole territory of a country and each housing unit and household requires a well-organized workforce of enumerators and supervisors, who play a critical role in the accurate and complete enumeration of the population and living quarters. Uniformity in conducting the census, thus ensuring consistency and equal quality of collected information, is of paramount importance, and is achieved by following instructions as provided in the enumerator's and supervisor's manuals. In turn, those manuals need to be comprehensive in their coverage of all possible situations and interpretations of responses by interviewees in order for them to provide sufficient information for both enumerators and supervisors to work independently in the field.

4.100   In the light of contemporary concerns regarding the confidentiality and privacy of individual information provided for statistical purposes, enumerators and supervisors require special training in relation to these concerns. This part of the training would rely on provisions regarding the confidentiality of statistical information[64] as well as census legislation.

6.1   Role of supervisors

4.101   The duties of supervisors vary from one country to another depending on many aspects regarding field organization, method of enumeration and method of quality assurance of the field enumeration. The main responsibility of supervisors is to supervise the work of several enumerators within the supervisory area,[65] And ensure that they complete their work accurately and in a timely manner. In general, the supervisor has three main duties:
(a) training the enumerators under their supervision; (b) distributing precise and unambiguous

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[64] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part three, chap. X, section B.5.

[65] Ibid., part three, chap. VII, section C.

assignments to the enumerators under their supervision; and (c) controlling the quality of the work undertaken by each enumerator on a daily basis.

4.102   As for methods for controlling the quality of the work of enumerators, they will vary depending on the enumeration method and technology applied. In general, they consist of verifying that the enumerators have (a) updated the maps; (b) visited all listed living quarters; and (c) completed the questionnaires for all households and each person living in the household. These tasks involve regular and direct interchange with the enumerators and revisiting the households in the field during enumeration and after enumeration has been completed.[66] Supervisors can also be called upon to explain to households or community groups the purpose of the census and the importance of providing complete and accurate data.

4.103   During the course of the enumeration certain challenges will arise that will require special intervention by supervisors. The most likely challenges, along with examples of appropriate interventions, are given below.

(a) **Refusal to give information.** In cases where the enumerator has not been able to secure the cooperation of the household, the supervisor should intervene and directly explain the importance of providing information and the confidentiality of the information provided.

(b) **Difficulty in gaining entrance.** In the case of gated communities, the supervisor should make contact with the agency that provides security services to the gated community to secure permission for the enumerators to be admitted. If the supervisor encounters difficulty, then the matter should be referred to the regional census office for its intervention (in some countries, refusing to provide access to census takers represents a felony, as a consequence of which law enforcement agencies may also be involved). In the case of communities where access to a household is contrary to traditional or religious practices, the role of the supervisor is to undertake early communication with the leaders of these communities to ensure full cooperation with enumerators.

(c) **Ensuring the safety of enumerators.** In areas where the principle of "safety in numbers" should be followed, it is the role of the supervisor to ensure that the interviews are conducted by groups of two or more enumerators accompanied by their supervisor. In areas where even this approach is felt to be inadequate in terms of ensuring security for enumerators and supervisors, law enforcement services should be requested to provide protection. In order to reduce the time enumerators spend in such areas, team enumeration should be employed to accelerate the process.

(d) **Securing cooperation from immigrants and refugees.** Where enumerators encounter difficulty in obtaining information from such groups, the supervisor should

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[66] See section D of the present chapter for more explanation about the role of supervisors for quality assurance of the field enumeration.

emphasize to them that all information given will be treated confidentially and will not be used for immigration purposes or shared with any other agencies.

4.104　First-level (field) supervisors are required to report to second-level (district or similar) supervisors regularly on the progress in their supervisory area and on the performance of enumerators to ensure complete enumeration in a timely manner. See chapter III for more elaboration on the duties of supervisors.

6.2　Role of enumerators

4.105　Enumerators are responsible for accurately recording all required information on the living quarters, households and each individual living in a assigned area and reporting on progress to their supervisors. It is important to make sure that the enumerator`s manual and instructions are well understood by the enumerators through the provision of efficient training supervision mechanisms.[67]

4.106　The main duties of enumerators can be classified according to the three phases of the enumeration (see chap. III for more information about the duties of enumerators).

Before the enumeration:

    (a) Attending the training courses and studying the questionnaires, the manual and instructions;

    (b) Obtaining all census materials, including census questionnaires, maps and forms.

During the enumeration:

    (a) Identifying the boundary of the enumeration area and other landmarks;

    (b) Updating the address list and the census maps provided;

    (c) Visiting all living quarters and enumerating all individuals according to the type of enumeration;

    (d) Enumerating the homeless in the given enumeration area;

    (e) Filling out the field enumeration sheets;

    (f) Reporting progress to the supervisor periodically.

Following the enumeration:

    (a) Checking the field again to ensure that all living quarters have been visited and all people covered;

    (b) Filling out the forms and submitting all census materials to the supervisor.

4.107　Errors by enumerators translate directly into either content errors or coverage errors, with adverse effects on the quality of the overall census and its results. Thus, while all efforts need to be made in terms of training enumerators and ensuring fair compensation for their

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[67] See chap. III, sect. G, on field staff training.

work, it is also of paramount importance to develop methods and techniques to supervise their work in the field through regular and frequent checking of both the quality of collected information and the coverage of units in the assigned enumeration area. In that context, it is also necessary to ensure that enumerators are well aware of the consequences of inadequate work, which can compromise the confidentiality and the privacy of collected individual information, and can even result in dismissal or criminal prosecution.

7.   Living quarters and household listing

4.108   A list of living quarters and households,[68] made available at the beginning of the enumeration, helps to monitor the completeness of the enumeration of the population in a given area. Such a list is also useful for the logistic organization of the field enumeration, as it can be used for: (a) estimating the number of enumerators needed; (b) estimating the time required for the enumeration; and (c) estimating the number of census questionnaires and other materials needed in a given area. It is also important for establishing necessary links between population and housing censuses when they are carried out separately.

4.109   It is likely that census maps contain errors, and sometimes these errors may be significant. Since the work for census mapping is conducted several months or even several years ahead of the enumeration, new structures may not be shown in the enumeration maps, which will need to be updated to show all living quarters and households.

4.110   Objectives in carrying out this fieldwork depend on the needs of a country, but may include:

   (a) Listing all living quarters and households to provide updated maps, including for remote and rural areas;

   (b) Updating the list to correct existing maps, in particular if a country experiences significant construction and growth of new settlements;

   (c) Updating the list of addresses for self-enumeration, whereby questionnaires are sent to households by mail.

4.111   The fieldwork for listing the living quarters should be carried out several months before the enumeration if the aim is to update the existing census maps, or if there is a need for an accurate address list for self-enumeration. A listing of sets of living quarters, particularly in densely settled locations, cannot be compiled unless streets have names and building have unique numbers. Individual apartments in multi-dwelling buildings need to be numbered or otherwise unambiguously identified. Where these prerequisites do not exist, numbering immediately prior to the census would prove useful.

4.112   Listing the living quarters can be conducted during the enumeration before starting the actual enumeration in the field. Enumerators can check the census maps in the field and

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[68] For definitions of living quarters and households, see *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part four.

prepare the list of living quarters and households as a first assignment during the enumeration. This field exercise has many advantages:

(a) Enumerators and supervisors will gain familiarity with the area for which they are responsible before starting the enumeration.

(b) Errors related to the boundaries of enumeration areas – overlapping or failing to include some living quarters – can be identified at the beginning of enumeration.

(c) New living quarters not included in the maps can be added, and demolished units can be identified. The updated maps can be passed to the cartographic staff to follow up with revisions to the official maps.

(d) Additional enumerators can be assigned to the area at the beginning of enumeration, if the updated list cannot be completed by one enumerator in the given period.

(e) The updated list can be used for monitoring coverage during the enumeration.

4.113   If a population registration system is in place, the address lists can be easily generated from the registers. These lists can be updated during enumeration and used for improving the population registers by reporting any discrepancies found in the field. Also, in some countries the existence and regular maintenance of the register of addresses provides an invaluable resource.

C.   Monitoring and management of field enumeration

1.   Introduction

4.114   The key to successful monitoring of the field enumeration is an efficient and relevant management information system. However, collecting management information for this activity is difficult because of the large numbers of field staff involved and the fact that these staff are often widely dispersed geographically. Therefore, it is important to ensure that the information collected is needed and will be used constructively in the management of the operation. The information can be collected and transmitted by a variety of methods (for example, telephone, fax, email, instant messages, SMS, business intelligence systems, web-based applications, survey management modules on handheld electronic devices).

4.115   A survey management system as a component of a well-designed digital data collection operation could greatly assist the monitoring and management of field enumeration. One major advantage of such a system is that the quality of data and the performance of field staff, as measured by completed interviews, can be monitored almost in real time. The case management tools of such a system often offer functions for all levels of survey staff. For interviewers, these programs may offer a dashboard with assigned cases and their status, where interviewers can resume an interview or start a new case. For supervisors, these programs may provide a summary of survey operations under their supervision, showing cases that supervisors have assigned to interviewers as well as cases that supervisors have not yet assigned to interviewers but that have been assigned to their team. This is where

supervisors can make assignments for their team, review completed cases and generate reports on progress. For survey managers, these programs provide a mechanism both for making survey assignments to teams and for reviewing their progress through reports. This is where survey managers allocate and adjust field assignments, as well as generating reports.

4.116   The issues outlined in the present section are applicable to whichever method is used.

4.117   The nature of the field operations means that management information may take some time to be acquired and received by the intended user. If it is determined that the information cannot be acquired in a timely enough manner to be used effectively, it should not be collected. Alternatively, the type of information or level of detail should be reconsidered and reorganized.

4.118   A key point is that a small amount of good information will be of more use than a large amount of poor or incomplete information. If the information cannot be used effectively, there is little point in collecting it.

4.119   Some countries equip each regional office with computer, printer, telephone and fax services. Service centres are established with a special census hotline for receiving enquiries from the public and the field staff. The central office of the census agency receives enquiries, the census key staff discuss them and then send the answer to the intended party. Sometimes, the answer to an enquiry made on an important point is circulated to all field offices.

2.   Planning a management information system

4.120   Planning a management information system for the field operations should comprise the following steps:

(a) List all potentially useful items of information, for example, number of applications received for field positions, dates that training is to be started and completed, and number of dwellings interviewed or enumerated. Wherever possible, have benchmark data for comparison, for example, the number of positions available compared with the number of applications received.

(b) Consider how and when each item of information may be collected.

(c) Consider how each item of information will be used and by whom. For example, information about application shortfalls may be used to start action to attract more applicants by different means.

(d) Review the value and usefulness of each item with a view to keeping the list to the minimum of those considered essential or highly desirable. Items considered low priority should only be included if the cost is marginal and there is at least some evaluation use for the information.

(e) Incorporate the final list into relevant workplans.

4.121   The type of information to be considered as part of the management information system should improve the ability of managers to:

(a) Ensure that the field operations proceed according to schedule;

(b) Respond to public relations issues;

(c) Ensure that field staff are paid correctly and on time;

(d) Manage the budget;

(e) Evaluate the effectiveness and efficiency of the operation.

4.122   The nature of the information that may be collected varies. It may include the following:

(a) Date or dates that particular activities are started or completed;

(b) Piece rates or amounts, such as number of dwellings interviewed or enumerated;

(c) Volume, such as percentage of enumeration completed;

(d) Status, such as incomplete, started or finished;

(e) Type (and number) of calls to the telephone enquiry service (including number of certain types of calls).

4.123   The information may also be required at different levels in the management hierarchy. For example, the number of applicants may be reported at the regional level, while the status of completion of a particular activity may be reported at the enumeration area level. It depends to a large degree on who is going to use the information and at what level of detail.

3.   How to collect management information

4.124   The methodology used to collect management information depends largely on the technology and communications infrastructure available to the census agency and temporary field managers and staff. Information can be transmitted between the different field management levels and the census agency as follows:

(a) Electronically (email, telephone, mobile devices, Internet and so forth);

(b) By the postal service;

(c) With the return of the bulk census material.

4.125   The use of each type of transmission will impose its own requirements as far as the style of reporting is concerned. For example, email and fax may use a standard form designed for that purpose. An electronic operational control system would have these forms digitized and the information contained on them continually updated. Telephone transmission may require the recipient to use a form designed for ease of receiving verbal information and to maximize telephone operator effectiveness. Returning information by a postal service may require that management books allow for the removal of single duplicate pages.

4.126   The relative urgency of some types of information may dictate the method to be used. For example, information required to pay temporary field staff may need to be transmitted by

post or electronically rather than waiting for the bulk census material to be returned to the processing centre.

4.127   In some cases, a number of different methods may be used to send information from the enumerators to the census office. For example, enumerators may make a verbal report to their supervisors, who then use the telephone to send a consolidated report to the regional office, where an email report is sent to the central office.

4.128   These factors need to be considered within the context of the particular country. What will work in some countries may not be appropriate in others.

4.   Where to start

4.129   Like any census activity, it is not possible to plan the management information system for field operations as a single isolated task. Information requirements should be considered for each area of the field operations, dependencies identified and requirements consolidated into a plan. The consolidation phase should include discussions with other stakeholders of the field operations phase.

4.130   The information requirements can be expressed initially in the form of questions. The actual data requirements can then be derived from the questions. For example, to answer the question "Have all field staff been trained?" the data requirement would be a yes or no status report from field managers. In turn, this may be recorded in the field manager's control book as a record of the date training was completed (a date equals a yes status, while no date equals a no status).

4.131   The question method is useful in "what if" planning sessions to start developing ideas. A small group of people from stakeholder areas can hold discussions about the questions to which they need answers. Questions are written down throughout the session and reviewed afterwards. This review begins the process of prioritizing and identifying particular data requirements.

5.   What to collect

4.132   Included in the present section is a list of areas in the field operations and types of management information that may be collected. It is not an exhaustive list but is a useful starting point for planning. More detailed information about particular aspects of the census can be obtained from other statistical agencies, in particular those with similar attributes and infrastructures that have recently taken a census.

5.1   Budget

4.133   In field operations, a significant proportion of the census budget is usually spent on salaries for temporary field staff. Furthermore, a high proportion of this expenditure is incurred over the brief enumeration period. As a result, usually little can be done at that time to resolve budget difficulties.

4.134   Therefore, management information data must be gathered early enough to ensure that sufficient funds are available to undertake the work. More senior staff (especially regional managers and supervisors) should provide an evaluation of the workload in their areas before enumeration commences so that potential problems can be identified and resolved. They are then responsible for ensuring that their staff work within that budget.

5.2   Mapping and household listing

4.135   The mapping area provides the basis for most logistic planning for the field operations, as well as the crucial details of the number of enumeration areas and their estimated sizes. In some cases, the mapping will be done before the household listing exercise, if this is undertaken. In other cases, it may be conducted during or after household listing.

4.136   When mapping is carried out as part of household listing, the data collected can reliably be used for subsequent census management tasks. For example, information about the estimated number of households in each enumeration area would be aggregated to management levels and used to check that sufficient materials were being dispatched to the particular area. The actual number of field workloads can be used to check the budget.

4.137   Mapping and household listing is usually a large exercise that takes a considerable amount of time to complete. Therefore, the work should be scheduled and management information requirements managed in a way that enables packets of information to be added to the management information system progressively.

4.138   Specific management information data items from mapping and household listings may include the following:

  (a) Number of enumeration areas;

  (b) Number of management areas;

  (c) Estimated households in each enumeration area;

  (d) Estimates of potential travel requirements;

  (e) Intelligence about problem areas.

5.3   Logistics

4.139   Logistics is another key area for early information management and surveillance. Information about the number of workloads can be used to determine the amount of material needed to complete the enumeration, which in turn can be aggregated to determine print quantities. Availability of these estimates in the early stages of planning will enable an accurate costing of materials. They will also assist in establishing realistic schedules for activities such as printing and transport. The processing centres can also use these estimates to prepare for the estimated volume of material, as well as estimates of the number of workloads and records to be processed.

4.140   Management information on logistics is based around three broad areas:

   (a) Material acquisition and preparation;

   (b) Delivery of materials in bulk into the field and to enumerators;

   (c) Return of materials from the field to the processing centre.

4.141   Material acquisition and preparation specific to management information may include the following:

   (a) Number of materials ordered and received (for example, number of census forms printed);

   (b) Date of receipt of materials;

   (c) Amount of material and date prepared (packing, management books and maps);

   (d) Amount of material and date dispatched to, and received at, each management area;

   (e) Amount of additional material requested (for evaluation purposes);

   (f) Number of forms expected to be mailed in (where applicable) from the enumerator's record book;

   (g) Number of handheld devices delivered or pre-positioned;

   (h) Handheld devices checked in or out by field staff.

4.142   The method of packing material will determine the units of measurement (see chap. III, sect. I, above).

4.143   For the delivery and return tasks, the key management information items will be the dates on which these tasks were completed for specific geographical areas.

5.4   Recruitment

4.144   Management information about recruitment is aimed at enabling census managers to ensure that there are sufficient applicants from which to select suitable candidates for all field positions. A strong field of applicants increases the possibility of obtaining good-quality field staff. However, turnover of staff has to be included in the recruitment equation and computation.

4.145   Specific management information items may include the following:

   (a) Number of positions available, by management area (from the mapping system);

   (b) Number of applications received, by day (during the recruitment period);

   (c) Number of applications initially rated acceptable (where practical).

4.146   During the recruitment activity, emphasis should be given to information that enables managers to respond to shortfalls of applicants in particular areas.

5.5   Training

4.147   Well-trained enumerators are essential to the successful carrying out of a census. Information about training is reflected in reports from field supervisors and managers that training has been conducted before the staff commence enumeration work.

4.148   Specific management information items may include the date training was completed and the number of staff trained.

5.6   Operation

4.149   Information to support, and later evaluate, the field operations is mainly obtained from records created by field staff or enquiry service staff. In some cases, the information may be received in time to respond with action (for example, calls from householders that forms have not been delivered or that the enumerator has not called). However, most information obtained during the operation is used for subsequent evaluation purposes.

4.150   Much of the information is obtained from control books and other records (such as packing slips) that are eventually returned from the field. The objective is to ensure that information being recorded is useful. Even if the information cannot be acted on to rectify a problem in the field, it can be used to inform processing centre staff about potential data quality issues. It can also be evaluated later on to improve the operation in future censuses.

4.151   In a digital census, it is much easier to gather intelligence metrics in real time and spot problem areas to take early action.

5.7   Public relations and enquiry services

4.152   Where a service is provided for respondents to call the census office, the management information that can be obtained is of enormous value. Such services will be of particular value where the collection is undertaken on a self-enumeration basis rather than by interview.

4.153   In some cases, such a service enables corrective action to be taken in the field, while in others, it may alert census managers to a need for additional widespread publicity about the census.

4.154   Calls to such a service should be logged and some basic information recorded. This may include:

(a) Time of call;

(b) Location of caller (enumeration or management area);

(c) Reason for call.

4.155   The reasons for the calls should be monitored to detect emerging problems requiring corrective action.

D.   Quality assurance for field enumeration

1.   Introduction

4.156   Quality assurance during field enumeration tends to identify problem enumerators within the enumeration workforce rather than systemic or process errors. This is a consequence of the brief duration of the enumeration activity and the limited scope for improving this process once it has commenced.

4.157   The strategies outlined in the sections below will enable these enumerators to be identified. However, these strategies will also allow evaluation to occur after enumeration so that improvements can be made to future censuses. These quality assurance strategies can also be implemented in any pilots leading up to the census so that identified problems can be addressed before the census.

4.158   Section 3 below assumes that the census is face-to-face interview based. Countries that use a self-enumeration, drop-off and collect approach should in particular adapt section 3 to focus on the respondent contact elements and omit those parts specifically dealing with interviewing. Sections 4 to 6 are relevant for both face-to-face and self-enumeration methods.

4.159   The scope for quality assurance in field operations is more restricted where the mail service is used for the delivery and return of forms.

4.160   The present section also concentrates on the quality assurance conducted by supervisors on the work of the enumerators. Ideally, managers may also wish to conduct spot checks on the work of the supervisors. However, it is recognized that in reality, owing to other work pressures, this may prove difficult for managers to organize.

2.   Role of supervisors

4.161   Supervisors play a critical role in assessing and reviewing the performance of enumerators and ultimately influencing the quality of the census. The supervisor is also an important link in terms of evaluation of the procedures, documentation, and training for census tests.

4.162   By adopting quality assurance, and collecting and analysing quantitative information, an important aspect of the overall quality of the census can be substantiated. In problem cases, these checks may enable corrective action to be taken before census forms leave the field. These procedures also provide census management with information about the quality of the enumeration.

4.163   These quality assurance checks during the main census enumeration provide valuable information after the census. The information can be used to inform the processing area about potential problems and can contribute to the evaluation of census enumeration.

4.164   Supervisors need to be trained in the procedures required for conducting quality assurance on the work of enumerators, and need to have a thorough knowledge of the enumeration procedures. It is acknowledged that supervisors have an extensive role in terms

of supervision; however, the material contained in the present section concentrates on their role in quality assurance.

4.165   Details on quality assurance processes will need to be included in the supervisor's guide or handbook. Interviewers will also need to be advised that quality assurance procedures will be adopted. This has the added benefit of reinforcing to interviewers the need to follow all procedures, and assuring them that their supervisor will be assisting them by checking their work.

4.166   During training, supervisors should emphasize that, apart from being a means of quality assurance, these checks are also designed to help enumerators to become proficient in their work quickly. Where significant problems are identified, the supervisor must assess whether the interviewer requires further training to overcome the problems.

4.167   The overarching role of a supervisor is to:

(a) Provide retraining of enumerators who require it following their initial training course;

(b) Enhance the performance of enumerators through practical advice;

(c) Provide support and encouragement;

(d) Provide contact, open communication and feedback;

(e) Perform quality assurance on the work of enumerators;

(f) Ensure recommended improvements are implemented.

4.168   In practical terms, the duties associated with the role are to:

(a) Ascertain that the enumerator has checked the maps and household list before commencing work;

(b) Observe the introductions to a sample of householders;

(c) Observe the completion of a sample of questionnaires;

(d) Observe a sample of the editing work of the enumerator;

(e) Check on a sample of dwellings to ensure that enumerators have actually visited the households and completed the forms;

(f) Report to managers on the progress of quality assurance checks and emerging issues relating to the quality of enumeration.

4.169   Supervisors need to ensure that they establish a positive relationship with the enumerators. Supervisors need to establish a friendly atmosphere by demonstrating they are approachable and empathetic, and should attempt to put the enumerator at ease. Discussions should be commenced and conducted in a non-threatening manner. Supervisors should also give enumerators the opportunity to ask questions or make comments.

4.170   Performing quality assurance on the work of enumerators can be done in the following ways:

(a) Observing interviews during enumeration;

(b) Checking households already enumerated;

(c) Checking coverage of the enumeration area;

(d) Reviewing completed census forms;

(e) Reviewing monitoring and evaluation data for the area under supervision;

(f) Checking the consistency of the replies in the questionnaires.

4.171   Each of these is discussed in detail in the following sections.

3.   Observing interviews

4.172   Observing interviewers in the field is usually conducted early in the enumeration period, and less frequently later in the enumeration period. This pattern of observation is aimed at ascertaining whether interviewers have followed all of the instructions outlined in their handbook and at training. In part, it also acts as a form of on-the-job training.

4.173   Observing interviews will identify whether interviewers are:

(a) Following instructions on how to complete the forms;

(b) Understanding the concepts and basic definitions;

(c) Asking the right questions in the right manner;

(d) Able to establish good rapport with the respondents;

(e) Recording answers accurately.

4.174   For an example of an observation form and accompanying instructions from the 2010 census of the Philippines, see annex VI.[69]

3.1   Preparation

4.175   Before visiting any households, interviewers need to be advised that, after introducing themselves to the householder, they should introduce the supervisor as a person who is carrying out quality assurance. The supervisor's aim is to be "seen and not heard". However, particularly in the actual census enumeration, they may need to intervene to rectify a situation that would otherwise result in a number of incorrect questions being asked or, perhaps, questions being missed.

4.176   Before conducting any supervised interviews, the supervisor will need to do the following:

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[69] *2010 Population and Housing Census of Philippines: Supervisor's Manual.*

(a) Complete training of all interviewers;

(b) Arrange a mutually agreeable meeting time and place with each interviewer;

(c) Ensure that there is sufficient time between appointments, especially in rural areas where travel time could be significant;

(d) Ensure that they have access to a full kit of required forms, including census forms, and observed interview reports;

(e) Ensure that they have access to a set of interviewer's and supervisor's manuals and guides.

3.2   Interviewing technique

4.177   A good introduction at the door will help the interviewer to obtain a positive reaction and will assist with an accurate response to all relevant questions. When conducting an interview, the interviewer needs to:

(a) Make sure that they identify and interview the head of the household or any responsible member of the household (unless each person over a certain age is to be interviewed);

(b) Apply the customs and etiquette expected in the country or region concerned;

(c) Explain the census and how long the interview will take;

(d) Keep the respondent to the point, with respect;

(e) Pace the interview to allow the respondent time for thought without wasting time;

(f) Assess the situation in the household from the door;

(g) Be flexible enough to come back at a more suitable time;

(h) Maintain a friendly yet positive and professional manner;

(i) Be prepared and informed, and keep to the point.

4.178   The supervisor would assess the interviewer as "requiring improvement" if any of the above information was omitted. It is also important that interviewers leave the household in a positive and friendly manner because they may have to return to collect additional information later.

3.3   Scope and coverage

4.179   The supervisor should check that the interviewer asks the correct questions in order to establish who is to be included in or excluded from the scope of the census. While most people will be included in the census, the coverage rules for those who are to be included must be carefully applied. For example, if the census is based on place of usual residence, supervisors need to ascertain whether interviewers have only included usual residents. Similarly, if particular population groups are excluded from the census (such as overseas visitors), the supervisor must ensure that persons from these groups are not included. For an

example of quality assurance focused on coverage in the 2012 Rwanda Census of Population and Housing, see annex VII.

3.4   Completing the census form

4.180   There are three priorities for supervisors in relation to question wording:

(a) Identification and recording of any errors;

(b) Recording the initial asking of any questions;

(c) Recording the response to any questions.

4.181   In an interviewer-based census, the basic principle is that everyone is asked the same question and in the same manner. This approach is necessary if there is to be nationwide consistency and accurate data. Interviewers must read the questions as worded and not rely on their memories. Supervisors are required to stress the importance of this approach and to provide specific assessments on this matter as part of their observed interview report.

4.182   Supervisors should follow each interview with their own copy of a census form, and note when the interviewer has:

(a) Strayed from the actual question wording;

(b) Missed questions or asked questions that do not apply;

(c) Incorrectly directed answers through prompting rather than probing for a response;

(d) Recorded insufficient information.

4.183   The number of occurrences for each person should be recorded on the observed interview report.

4.184   The following scale could be used for scoring each question:

(a) **Exactly as worded.** The interviewer asks the question exactly as written, possibly adding only words such as "and" or "well".

(b) **Reworded, meaning the same.** The interviewer adds words, although the changes are only minimal, but does not change the actual meaning. Supervisors should record these additional words, as they will be valuable in test evaluation procedures.

(c) **Reworded, meaning different.** This category should be used if words are added, or key words missed, to the extent that the actual meaning has changed. For example, if the words "last 12 months" were omitted from the relevant question, the whole meaning of the question would be changed and it is left to the respondent to interpret what is meant by "usual activity". Once again, supervisors should record on the observed interview report the words that are actually used by the interviewer.

(d) **Not asked, response inferred.** This category should be used if interviewers decide they do not need to ask the question because they think they know the response, or,

perhaps, they forgot to ask the question. Supervisors should also mark the questions where this has occurred and record it on the observed interview report.

4.185   Not all respondents will understand the questions put to them by the interviewers. It is important that interviewers use correct probing techniques for clarification. It is the supervisor's role to assess whether interviewers are using correct probing techniques or whether they are prompting the respondent with their own ideas of what the response should be. This may lead to potentially inaccurate data.

4.186   If there is any confusion on the part of respondents, interviewers should seek clarification by, perhaps, repeating the question or by neutrally probing.

4.187   A probe or explanation is inappropriate if it changes or limits the frame of reference of the question, limits the response possibilities or suggests possible answers. This form of questioning is being directive and prompts the respondent to give a specific answer. This approach will lead to inaccurate data being collected and is therefore inappropriate. For evaluation purposes, supervisors should record where this happens on the form as well as on the observed interview report.

3.5   Completing the observed interview report

4.188   In completing the last part of the observed interview report, the supervisor should provide details of questions where interviewers had difficulties; comments on introductions, explanations given and closing remarks; and overall performance.

4.189   These summary comments should be provided on the basis of the earlier comments and the tallies of recordings from the previous pages. Care should be taken that comments are factual and positive. If, owing to an uncooperative respondent, it was difficult for the interviewer to complete the census form, this needs to be acknowledged on the observed interview report. Supervisors need to be concise, relevant, encouraging and constructive in their feedback. They should not be demoralizing and should use precise and explicit language is describing errors.

4.190   After the supervised interview is completed and they have left the household, the supervisor should discuss the evaluation with the interviewer, emphasizing the positive areas and pointing out any problems. The problems need to be pointed out in a positive manner. Any problems should be prioritized and their significance weighed in the context of the situation. Negative comments need to include suggestions for improvement.

4.191   Interviewers must be given the opportunity to ask questions, provide comments and indicate whether they agree or disagree.

4.192   In the case of extremely poor performance, supervisors may need to determine whether an interviewer should continue his or her employment. Before such a decision is made, extra supervised interviews should be carried out and supplementary training provided. However, in extreme circumstances, where interviewers have blatantly ignored instructions, they may need to be dismissed summarily.

4.193   The procedures for observing interviews may be different for tests and the main census enumeration. During tests, the supervisor would observe approximately four interviews before suggesting any changes. During census enumeration, the supervisor would suggest improvements after the initial interview was observed. This is because during tests, evaluation of training and procedures is important and may require a few observations to confirm the nature of the problem, whereas during census enumeration, the quality of responses is so important that additional incorrect information cannot be permitted.

4.194   In tests, analysis of the observed interview report will need to be carefully undertaken, and attention paid to the types and frequency of errors. The evaluation needs to consider whether the mistakes are being made by only one interviewer or by all the interviewers trained by the same supervisor, or if all interviewers are making the same mistakes. The answers to this evaluation will provide a good indication of where improvements need to be made. These could be in the:

(a) Quality of the interviewers;

(b) Interviewer recruitment programme;

(c) Master trainers or the training;

(d) Instructions.

4.195   This analysis can also be of assistance to the evaluation of other aspects of tests (for example, analysis of non-response to fertility questions by age groups and marital status). This could provide some indication of whether specific questions are being missed in certain circumstances and what those circumstances are. This would enable the interviewer's instructions and perhaps even the trainer's instructions to be reviewed before the main census.

4.196   An analysis of all errors on all completed test forms, dissected by interviewer training groups, will provide some indications of whether there are problems across the interviewing panel as a whole. This may indicate a possible problem with either the documentation or the instruction guides, or whether individual interviewers or individual trainers are at fault. This disciplined approach to analysing activities and occurrences will enable the census agency to substantiate its evaluation procedures.

4.   Checking households already enumerated

4.197   A second method of quality assurance is for the supervisor to return and check a sample of households already enumerated to ensure that the enumerator did indeed make contact. Checks can also be made on whether enumerators completed the form properly and without leaving questions unanswered. This process is often called a probity check and the results are recorded in a probity report.

4.198   The probity report will identify whether enumerators are actually calling at households, and whether rapport has been established with the respondent. The latter point is an indication of whether enumerators are managing the interpersonal aspects of their work.

4.199   Probity checking is an integral and necessary component of the quality assurance strategy. It is a positive aspect designed to assist the development and monitoring of enumeration. Probity checks are also a public relations exercise with the community. Probity checks will:

(a) Check and confirm whether an enumerator actually called at a dwelling;

(b) Monitor respondent reaction to the enumerator's visit;

(c) Establish whether the enumerator provided enough explanation.

4.200   In essence, probity checking is designed to give an indication that enumerators are doing their job. It is important that this be done early enough in the enumeration period to improve poor performance, and not wait until the work is nearly completed. If these checks are done too late, corrective action will be extremely time consuming and expensive. It is good practice to have three or four visits made to dwellings that the interviewer has recorded as having finished. While the selections would normally be at random, there may be cases where the supervisor determines that specific dwellings require close inspection.

4.201   When checking households that have already been enumerated, the approach can be simple. In essence, supervisors need to do the following:

(a) Introduce themselves and the census;

(b) Explain that the purpose of the visit is to conduct quality assurance;

(c) Establish who spoke to the enumerator and, where possible, speak to that person;

(d) Ask, "Was the enumeration [for example, interview) completed to your satisfaction?"

(e) Ask, "Do you have any questions about the census?"

(f) Thank the respondents for their cooperation.

4.202   In this probity process, supervisors record comments by the householder regarding:

(a) Whether the enumerator made contact;

(b) Whether the enumerator established rapport;

(c) Whether the interviewer completed all the questions (in an interviewer method);

(d) Whether there were any problems.

4.203   If there are a number of problems associated with the visits made to date, the supervisor will need to ensure that interviewers know exactly where they need to improve. Depending on the significance of the problems identified, supervisors may need to determine whether to do additional probity checks before or after they have provided feedback to the

interviewer. If significant problems continue, supervisors will need to discuss the matter with their regional manager or deputy regional manager.

5. Checking coverage of the enumeration area

4.204   The supervisor should assess that enumerators have covered all of the households in their allocated enumeration area and no others from adjoining areas. This can be done by reconciling the forms or cases in the enumerator record with household listing maps.

4.205   The map and household list can also be checked for any additions or deletions by:

   (a) Asking enumerators whether they have found any new or missed dwellings;

   (b) Checking the changes they have made;

   (c) Using local knowledge to ascertain any additional changes;

   (d) Doing spot checks of the enumeration area.

4.206   In some countries, enumerators are required to place a visual sign on the outside of households they have enumerated. This may be done by a chalk mark or by sticking an adhesive label on an obvious space. In these cases, the supervisor can quickly ascertain whether all households have been enumerated.

6. Reviewing completed census forms

4.207   The supervisor should scrutinize all census forms before the material is returned to the processing centre. This scrutiny is essential to ensure that enumerators have completed their work as required and that completed workloads are of sufficient quality for the processing phase. The nature of this scrutiny should include checking that:

   (a) All fields to be completed by the enumerator have been completed correctly;

   (b) All census forms are accounted for;

   (c) Census forms have been fully completed;

   (d) Summary information has been completed correctly.

4.208   This scrutiny should be carried out as soon as possible after enumerators have finished a portion of their workload. It does not have to be left until the end of the enumeration period. They can be conducted on a daily basis for workloads completed that day. Checks made at the start of the enumeration period will detect problems early and allow timely feedback to the enumerators.

4.209   For self-enumerated censuses, a review of completed census forms provides the most significant level of quality assurance. If the census is digital, automatic quality assurance can be performed by incorporating edit specifications into the checks made as respondents complete the census form. In cases of certain error, the application can be made to prompt the respondent for an updated response. If there is uncertainty, the case can be sent to a queue for in-person or call centre-based follow-up.

7. Reviewing monitoring and evaluation data for the area under supervision

4.210   Supervisors are also responsible for monitoring the progress of enumeration for the area under their supervision. In a traditional census, many of the measurements generated during enumeration are intended for analysis later. In a digital census, this information can be used to provide real-time quality assurance. These measurements may include:

(a) Percentage of households visited in an enumeration area;

(b) Time taken to complete each question or questionnaire;

(c) Number of cases completed per day;

(d) Percentage of housing units not interviewed (for example because of refusal, non-contact or unoccupied premises).

4.211   Supervisors may be responsible for monitoring these measurements and reporting abnormalities to the statistical office or taking predefined actions to remedy the situation. Exact procedures should be determined during the planning phase of the census to reduce as much as possible situations in which supervisors must make ad hoc decisions to respond to enumeration abnormalities.

E.   Type of technology for field enumeration

1.   Introduction

4.212   Decisions regarding the use of technology for data collection should be made well in advance of, perhaps several years before, the beginning of the enumeration period. In paper-based censuses, technological tools could be added or subtracted from the census process on the basis of changing requirements or resource levels. For example, a statistical agency may intend to scan census forms, but difficulties obtaining the scanners lead to a decision to key in data capture instead. Although this decision would represent a significant change, requiring retraining of data-processing personnel and repurposing of equipment, it has been possible to make such an adjustment well into the census-planning process. The move away from paper-based censuses, even in the developing world, towards handheld data collection devices and self-enumeration through the Internet allows for instantaneous data capture and rapid processing, while simultaneously reducing flexibility for midstream change. The advanced infrastructure required to support data collection using handheld, Internet, and mail-out/mail-back methods limits the à la carte nature of technological options available before, during, and after data collection.

4.213   Field operations using handheld devices follow many of the same procedures as paper-based censuses. Digital data collection, based on either handheld devices or Internet-based self-enumeration, requires a suite of supporting technology, including well-designed databases and electronic operational control and dispatch. Digital data collection works best when integrated with a digital mapping and household listing system, though this type of integration is optional. The decision to use handheld devices for data collection must thus be

made early in the census-planning process. Technology allowing for instantaneous data capture represents a significant shift in census taking, allowing for rapid processing and more timely dissemination. Statistical organizations implementing electronic questionnaires seek to improve data quality through quicker detection of operational enumeration irregularities and capture errors. However, the sophistication necessary to develop and integrate these systems is still beyond the capabilities of many national statistical organizations. More information on planning for the use of electronic questionnaires is presented in chapter III.

4.214   The use of sophisticated technology for field operations in a census was traditionally very limited because of:

(a) The dispersed nature of the operation over the entirety of a country;

(b) Cost limitations;

(c) Lack of suitable infrastructure;

(d) The majority of field staff being temporary employees who only work for a short period, usually from their homes.

4.215   Telephone and fax have represented the main use of technology in the field. However, digital devices and systems that integrate these devices with the Internet are increasingly becoming viable tools in the management and operation of field activities.

4.216   The implementation of technology for field operations has two objectives. These are:

(a) To improve the efficiency of enumeration through effective communication between census management and field staff;

(b) To improve accuracy and quality of administrative and operational information recorded in the course of field operations.

4.217   Field operations have two distinct periods. The first period starts with the recruitment of temporary field staff and ends just before the enumeration activity begins. This period is characterized by times of intense activity, such as recruitment or training, with reasonably quiet times in between. During this period, accuracy and quality of administrative information is important.

4.218   The second period is the enumeration itself. During this period, speed and efficiency of communication is important in order to respond quickly to issues that arise in the field. Planning the field operations should aim to maximize the use of available technology but minimize reliance on unproven or unreliable technology. The use of technology should also be consistent across the country.

4.219   For example, the use of the Internet may be attractive. However, if it is only reliable in a small part of the country, it may not be cost-effective or efficient to have two systems in place: one based on the use of the Internet to communicate with some staff and another based on other technology to communicate with the remaining staff. Where new technology such as

the Internet is to be used, it must be subject to rigorous testing in the field before being implemented.

4.220   Another important consideration is the type of information transmitted and by what method. Care should be taken that any confidential information is transmitted by secure means. For example, faxes containing confidential data misdirected to a wrong number could prove embarrassing for the census agency. Data servers and transmission via the Internet must also be made secure to safeguard respondent data. Insecure systems could also generate bad publicity at a crucial time during enumeration.

2.   Types of technology

4.221   Technology can be used for enumeration, for the operation control system, or for providing the tools to create a system that integrates enumeration with operational control. The following are the types of technology that can be applied to field operations:

(a) Electronic questionnaires, for handheld devices and for Internet-based self-response;

(b) Handheld electronic devices;

(c) Internet;

(d) GIS;

(e) Contact centres;

(f) SMS;

(g) Traditional telecommunications technology.

2.1   Electronic questionnaires

4.222   An electronic questionnaire covers any digital data collection instrument, whether administered via face-to-face enumeration using handheld electronic devices such as tablets, smartphones or laptops, or self-administered to respondents via secure Internet.

4.223   Computer-assisted personal interview (CAPI) is an umbrella term for a set of survey technology that substitutes traditional paper surveys with electronic questionnaires on handheld electronic devices. For statistical agencies planning large-scale survey operations such as the census, CAPI has become an alternative with sizeable benefits compared with the traditional paper and pencil interview techniques, in particular where the length or complexity of the questionnaire suggests that there is a possible risk to the quality of data. The various factors that make CAPI more advantageous than paper-based techniques include the quality of the data and speed of delivery. Information on relevant characteristics and functionalities for the purpose of evaluating CAPI software packages is provided in chapter 2, section L, subsection 2.1.

4.224   Experience has shown that CAPI enhances the quality of census data in a number of ways. The main benefits of CAPI include:

(a) Ensuring that all mandatory fields are completed at the time of the interview;

(b) Instantaneous computer checks, correction of inadmissible or inconsistent responses that could be the result of either interviewer or respondent error, and cross-validation with other records;

(c) Smoother and faster interviews, thanks to automatic sequencing of questions and programmed skip patterns, eliminating the pauses and hesitations as enumerators turn pages and look for the next appropriate question on a paper questionnaire;

(d) More consistent interviews – because of the programmed skip pattern, the relevant questions asked of each respondent are based on answers provided, and, regardless of the enumerator, the sequence of questions will be the same, given the same set of responses;

(e) Built-in instructional and help materials for enumerators;

(f) Instantaneous or rapid transmission of data to central servers and rapid production of performance metrics associated with field operations, which can be used for monitoring and supervision of field operations.

4.225   One of the main advantages of CAPI is in its ability to reduce human error during data capture. A well-designed CAPI application can ensure correct data entry, improving the integrity and completeness of data collection. It can enforce basic business rules for data collection by ensuring that all compulsory fields are captured and verified using consistency controls and that the proper skipping patterns are followed. Real-time data validation checks can correct inadmissible or inconsistent responses that could be the result of either interviewer or respondent error. For example, range checks can be carried out to ensure that an answer falls within an acceptable range. CAPI also allows logic checks that can identify inconsistent or contradictory responses. The program can raise an error message, allowing the interviewer to investigate the inconsistency. Range and logic checks are powerful features of CAPI that improve the quality of the data at source.

4.226   The way CAPI navigates the questionnaire through programmed jumps is one of its most impressive features. Rather than having to decipher routing instructions during an interview, the computer program takes interviewers automatically to the next appropriate question. For instance, if a person participating in a survey reports being employed, an additional section enquiring about the occupation, status of employment, working hours or income can be displayed. This is particularly important when the questionnaire includes complex routing or skip patterns. Similarly, if a set of questions has to be asked a number of times (for example, for everyone in a household), the software will automatically repeat the questions the correct number of times and then move on. CAPI's routing capabilities have two main advantages over paper questionnaires. First, the possibility of error from interviewers failing to follow routing instructions is eliminated; they cannot follow a wrong route and ask inappropriate questions, nor can they inadvertently skip over questions. Second, the interview flows much more smoothly, since the interviewer does not have to keep referring to earlier answers to establish the correct route through the questions.

4.227   Interviewing is also made easier by the customizing of questions. The data capture software can recall a piece of data from its memory, such as a name or a date, and insert it in the appropriate place in a question. Using CAPI, interviewers do not have to keep a check on which member of the household they are collecting information on. In this way the accuracy of the questions and the smoothness of the interview are both improved. Responses to open-ended questions can also be typed in directly. There is no need for separate transcription later.

4.228   The use of CAPI significantly reduces the time lag between data collection and data analysis. Since the data are captured during the interview and basic consistency checks are performed at the same time, the processing phase of the survey can be done more quickly as less editing, imputation and validation of the collected data are required during the processing phase. It is important that decisions on the edits built into the CAPI application be made within a context of balancing the time required to complete a questionnaire (that is, system performance and respondent burden), and ensuring the high-quality data required for the subsequent processing phase.

4.229   In planning and designing electronic questionnaires for CAPI implementation, census managers need to take into consideration the hardware specification, in particular the memory capacity, of the handheld device to be used by the interviewers. This may impose a constraint on the length and complexity of the questionnaire. When developing the CAPI program, it may be found necessary to assess whether some questions or consistency checks and edits could be refined or cut down so as not to exceed the capacity of the handheld device. As the process of amendment and refinement continues, including after the pilot exercise, it is important that census managers and subject matter experts keep collaborating with CAPI program writers.

4.230   As census agencies migrate from paper and pencil to CAPI, they should identify a suitable CAPI software package that best meets their needs. In this process consideration should be given to factors such as institutional, human, computing, and financial resources, functionality and characteristics of the CAPI software, and vendor support. To the extent possible, the determination as to whether a given package meets the needs of a census operation should be based on hands-on experience and field tests. In evaluating a CAPI system, the following testing steps are important.

(a) **In-house questionnaire testing.** An initial test of the CAPI data entry system should be conducted within the statistical agency, ideally by staff members who are familiar with the questionnaire and subject matter. This will help to resolve the most obvious errors prior to the field pretest.

(b) **Field pretest.** This is the first opportunity to test the CAPI-based data collection system in the environment in which it is to be used. Interviewers and supervisors should conduct realistic interviews with real households. This provides both a training experience for the field staff and a test of the data entry system.

(c) **Modifications to questionnaire based on pretest.** On the basis of observations from the pretest, problems with field procedures and the electronic questionnaire must be

resolved. If necessary, changes should be made to the data entry system on the handheld devices. The result of this task is the final version of the data entry system.

(d) **Pilot test.** After the questionnaire is finalized in the previous task, the pilot will test the final questionnaire as it is implemented on the handheld device, and will also focus on connectivity and communications. This will test the network infrastructure and ensure that interviewers and supervisors are familiar with data transfer procedures. This will ensure that all of the changes based on the first pretest have been properly implemented and that the data can be transferred when needed. It will also ensure that all supervisors are able to provide the necessary support to their teams in the event of a technical failure in the field.

4.231 Box 27 presents an example from the 2010 census in Cabo Verde illustrating the necessary conditions, advantages and challenges of using handheld devices for enumeration.

Box 27. Necessary conditions, advantages and challenges of using handheld devices for enumeration: experience of the 2010 census in Cabo Verde

Necessary conditions

- When opting for use of new technology in census implementation it is necessary to take into account key investments in terms of technological infrastructure (such as hardware, software, GIS software) and technical capacity and skills in developing computer applications for mobile devices and establishment of IT and GIS units.

- In the census-planning phase, it is crucial to take into account the impact of the technology option on other phases of the operation. The technology type chosen for mapping and data collection has implications for the data-processing and dissemination channels.

- Experience should be gained in the use of the new technology in statistical operations (such as surveys) before it is implemented in a large-scale operation such as a census.

- New technology can greatly improve census quality. It brings gains in terms of coverage and reliability of data, allowing more efficient monitoring, data collection control, information processing, timeliness, and dissemination of results on multiple user-friendly channels (such as WebGIS).

Advantages

- More complete data collection on the statistical units (buildings and dwellings), as handheld electronic devices are equipped with a GPS signal receiver, greatly facilitating their localization and enabling georeferencing of new buildings;

- Consistency checks during the data collection phase enable information to be rectified at the interview stage;

- Optimized performance of the census enumerator in completing all mandatory questions and avoiding non-response and non-applicable questions;

- Improved work management by allowing tracking of real-time data collection in all locations, especially in cases where it is necessary to take corrective measures for data transmission;

- Elimination of time spent in post-interview data entry, as well as the costs of printing, transporting and archiving a large number of paper questionnaires;

- Reduced time used in variable coding;

- Improved timeliness by reducing the data-processing time.

Challenges and difficulties

- Costs associated with acquiring a large number of devices such as tablets or PDAs;

- Availability of adequate infrastructure and qualified staff required for the application of new technology;

- Lack of experience in using mobile devices for statistical operation, especially in developing software applications for cartography, data collection and supervision;

- Organization and management of the fieldwork, implementing data security methods through development of an online (including website) application for data transmission;

- Developing the data extraction program for data sets;

- Taking necessary measures to avoid loss of information caused by lost or damaged equipment, information-recording errors or failure in the backup process;

- Ensuring energy supplies and batteries when using mobile devices, where energy coverage in the country is insufficient.

Source: Instituto Nacional de Estatística, Cabo Verde.

2.2 Handheld electronic devices

4.232   The term handheld electronic device typically refers to a small device that provides computing and information storage along with retrieval capabilities. The typical handheld electronic device has a touch screen interface for input and output along with a miniature or virtual keyboard. Most handheld electronic devices have an operating system and can run various types of application software. Most are equipped with capabilities for connection to cellular networks and for establishing connectivity to the Internet and other devices (such as a PC and other mobile devices) through such mechanisms as Wi-Fi, Bluetooth, IrDA and near-field communication. The synchronizing function of these devices allows the exchange of data with a PC or other device. Recent developments have seen handheld electronic devices that employ video, audio and on-screen drawing capabilities to enable the collection of data in multiple formats. Such devices may also provide biometric user authentication, such as using the built-in camera for face recognition or using a fingerprint sensor for fingerprint recognition. Handheld electronic devices are available in a variety of form factors, including PDA, tablet computer, smartphone and ultra-mobile PC.

4.233   Devices may be purchased outright by the agency, shared between agencies, or rented, or a bring your own device (sometimes abbreviated to BYOD) model can be used. Decreased device cost and increased availability have widened the appeal of the BYOD approach. The statistical organization may also subsidize devices owned by census workers, independent of their employment by the statistical organization. Subsidy and the use of personal devices for the collection and transmission of confidential statistical data raise technical, security and legal considerations. Despite these concerns, the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, notes that a number of countries have used the BYOD approach for data collection since the 2010 round of censuses.

4.234   As the proliferation of handheld devices increases there can be financial benefits, as well as reduced training needs, if field officers can utilize their current device rather than be provisioned with a new device. Another significant consideration is the fact that mobile phones operate on different platforms and easily switch between different languages; developing applications that would enhance communication and monitoring would necessitate developing platform-agnostic applications, possibly raising costs and extending development time.

4.235   The decision to use handheld electronic devices requires a careful investigation of the feasibility of using such devices for data collection. A variety of devices exist offering different options and functionalities. The requirements of the device to use would ultimately depend on the business needs of the census agency. Generically, all organizations would need to take into account (a) device specifications (such as processing speed, display size, ruggedness, memory, connectivity options, battery life and alphanumeric keyboard); (b) potential application for various aspects of census operations (for example, integrating census maps and collecting real-time data for management and supervision of field enumeration); (c) budget availability; and (d) the required accuracy for the fieldwork application , especially if GPS functionality is important (see chap. 2, sect. L. 2.1 for more information on evaluating requirements for handheld electronic devices).

4.236   In order to harness the full potential of digital data collection, census agencies will need to carefully consider aspects of digital data collection, including (a) the data transfer system for transmission of data to central servers at the headquarters of the census agency; (b) data security issues for ensuring the integrity and reliability of the digital collection system; (c) training of enumerators in the use of the selected handheld electronic device; (d) the provision of technical support during field operations; and (e) field supervision and workflow management. These aspects are considered further below.

(a) Data transfer

4.237   A data transfer system needs to be built to facilitate the transfer of data captured by the enumerators using handheld electronic devices to a secured central database at the headquarters of the census agency. The plan to build a digital field data transfer system should consider all available means of data transmission. Where the communications infrastructure permits, cellular data connectivity provides a powerful tool for transferring data

directly from remote handheld electronic devices in the field to central servers. The ability to transfer data remotely without the need to work within specific Wi-Fi hotspots is a powerful mechanism for efficiency and reliability. However, the fact that cellular data are metered means that the frequency of transmission and amount of data sent in each exchange can have significant cost and performance impacts. Three broad technical areas must be understood in planning and implementing a cellular data application: (a) network performance constraints, including network coverage, network reliability and network bandwidth availability; (b) network overhead, including costs for data transmission and addressing security concerns through the implementation of encryption; and (c) application performance, including in the handling of connection and response delays. Before implementing a data transfer system using cellular technology, census agencies will need to carefully consider these technical requirements in order to achieve maximum benefit and meet cost targets.

4.238   Where the infrastructure for cellular network coverage is poor or non-existent, alternative mechanisms need to be developed for the transfer of data from the field. This will require establishing multiple data collection stations with means of connectivity to central servers at headquarters. The data collection stations could be computer equipped (with microcomputer, Wi-Fi, broadband access and modems) or not computer equipped (only modem and phone line available). Where necessary, partnership agreements could be struck with public entities such as townships, the armed forces or the postal service in order to access their phone lines, computers and intranet connections to complement the census agency's own field network. Radio antennas for Internet connection could be deployed to provide broadband service in remote areas where the existing telephone system is inadequate for data transmission. Enumerators at data collection stations could use means of connectivity such as Wi-Fi, Bluetooth and USB cables to download data from their handheld electronic devices. In such manner, data can be periodically transmitted without the need to wait until an enumeration area is completed – enabling centralized monitoring of the data collection, and allowing review and analysis to begin sooner. Saving data onto a secure digital (SD) memory card available on the handheld electronic device can help to avoid data loss in case of device crash or freeze-up or until the collected data are downloaded at the data collection stations.

4.239   Planning for the digital collection system should include a thorough testing of the data transfer system during the preparations and the pilot test. The data transfer system should be ready and thoroughly tested before training begins.

(b) Data security

4.240   Security is central for ensuring the integrity of a digital data collection system. The development of security policies and frameworks is key to ensuring that data are not compromised or altered at any stage during processing, including during collection in the field, monitoring and management of collected data. Several security concerns and risks should be addressed, including insecure data storage, virus attacks, hardware failures, weak server- and client-side controls, insufficient transport layer protection, poor authentication

and authorization systems, broken cryptography, sensitive information disclosure, and physical security of the device along with the captured data.

4.241   Security measures that could be taken range from basic ones to sophisticated encryption schemes. Data being downloaded from a server present a point of weakness if the server is not protected. To ensure security, login and authentication mechanisms should be put in place with relevant levels of access to the data upon extracting, importing or downloading. Encryption is an essential security protection measure while data are stored on the device, during transmission over cellular networks to servers, and upon extraction from servers. During upload of data to the server over cellular networks, data are usually encrypted and sent in secured packets across the network. However, once the data reach the wireline network of the cellular carrier they may be transmitted in the clear. This requires measures for ensuring security end to end between sending and receiving equipment. If data are not encrypted on the device, they may be open to virus attacks that risk the data being lost or altered. Encryption is important, especially in cases where there is no immediate synchronization with the server side from lack of cellular signal. Encryption allows for the data on the device to be temporarily and safely held on the device until they are transferred.

(c) Training

4.242   Training is a key factor for the success of digital census data collection. The use of handheld electronic devices requires a number of new skills from census enumerators. The training of enumerators should be a two-stage process that involves formal didactic sessions followed by extensive hands-on, in-the-field training. The training should be oriented to cover an overview of the collection methodology and design as well as to provide extensive instruction on how to use the handheld device, including switching on the device and entering the password, loading or selecting a questionnaire, entering responses to a questionnaire, charging the battery, general device maintenance, and how to insert and remove SD memory cards. In addition, training on uploading data from an SD card to a laptop, renaming files, zipping, encrypting (to ensure data security) and emailing the folders to supervisors should be included. The training sessions should ensure that all enumerators are proficient in the use of the device and in independently navigating their way through the electronic questionnaire. Supervisors also need to be very comfortable with the data collection applications.

(d) Technical support

4.243   The provision of technical support to assist enumerators during field operations is critical. Technical support could be provided in a number of ways, including through instructional and help materials built into the handheld device, documentation on the handheld device, deployment of technical support specialists to provide first-line field support, or a call centre set up to assist enumerators with any difficulties and troubleshooting problems encountered while capturing in the field. Troubleshooting in the field might involve addressing user errors in using the system, program malfunctions, lost data problems, viruses on the handheld device and SD cards, frozen device, problems transferring data, and upgrading programs. An electronic forum could also be set up to provide support to

enumerators and field supervisors. By logging into the forum, enumerators and supervisors could raise questions or concerns about field activities, and have those questions or concerns addressed by headquarters, or read information already available on topics that have been addressed previously.

(e) Supervision and management

4.244   The adoption of handheld electronic devices requires a well-designed system for workflow management and field supervision. All supervision tools used in the traditional paper-based data collection system should be replicated by automated systems. This requires replacing the practice of visual checking of paper questionnaires by supervisors with reviewing data in the enumerator's handheld device directly, and from reports and alerts generated by the digital collection system. A survey management system could be designed to control the flow of administrative, technical and operational information for the census in a centralized manner, with tools made available for each level of survey staff (enumerators, supervisors and managers). Such a system could give census managers access to information on all enumerators and supervisors (including the serial number of the handheld device assigned to that person), the census enumeration areas assigned to each enumerator, and the enumerators assigned to each supervisor. Data received from the field could be aggregated, providing information at enumeration area level, and fed to the survey management system. Such a system could have a set of indicators, computed at the census enumeration area level, for assessing performance status and quality and for highlighting areas where problems are encountered. On the basis of monitoring and quality assurance requirements, the system could be designed to generate automatic messages and alerts that are transmitted for action by managers, supervisors and enumerators, depending on the circumstances.

4.245   One of the biggest advantages of such a system is the ability to use the continuous transmission of data during field collection to track the progress of data collection and to assess where operations are running smoothly and where problems are encountered. This allows supervisors and managers to identify problems immediately as they arise and to take corrective action. If necessary, a case could be redirected to the enumerator so that they could return and verify or correct the information that caused concern.

4.246   Where the collection system is integrated with GPS applications, each device in use by a single enumerator or enumerator team can link a case with the enumeration area so that the records are tagged with the respective enumeration area. This can aid in avoiding duplication and enhancing operational control. This allows the supervisor and area manager to get useful, real-time monitoring information when the enumerator starts up the handheld device, creating a record of who is working with the device and in which enumeration area. This is useful in monitoring which enumerators are experiencing problems and in which areas. The supervisor or area manager is then informed who can investigate the problems or issues as they arise. By using the GPS points they are able to quickly identify areas in which the enumerators are capturing information outside the boundaries or in the wrong area, or even places where they have not captured all the information. In such cases, the supervisor is

alerted and the issue can be quickly rectified, thus saving time and increasing the validity of and confidence in the data. Setting up real-time monitoring in the field for quality control also aids the in-field security of devices. Inactivity or downtime could be a result of data loss, theft or security breaches with respect to information transfer. Devices can also be geofenced so that they will only allow an interview to begin when the device is located in the correct area for that enumerator. Handheld devices are also able to capture metadata on the location of the interview, time of day and other metrics to assist in monitoring enumeration progress and measuring data quality.

4.247   For the digital data collection and management systems to work effectively, it is crucial that the data flow through the system smoothly. This means the handheld devices must be able to adequately process the questionnaire and data collected without slowing down the interview process. Management reports must be updated in real time, or at least daily, which requires an efficient means of transmitting data from the field to headquarters. Delays in the transmission of data from the field hinder the updating of the survey management system. Long delays in updating the system prevent it from working effectively as a real-time management tool, which in turn limits the effectiveness of the supervision functions. Where such a system is used as the primary tool for managing the field operations, contingency planning is needed to handle setbacks that compromise the quality of supervision of data collection.

2.3   Internet

4.248   Internet self-response entails the collection of response data via the Internet. A high level of Internet response could yield significant cost savings over paper-based census collection operation. These savings are realized through reduced cost of instruments and infrastructure for paper data capture, and, in the case of self-enumeration through mail-out/mail-back paper questionnaires, reduced cost of non-response follow-up workload. Internet self-response should also lead to improvement in overall data quality, as the Internet data capture system allows implementation of real-time preprogrammed edit checks to identify user error prior to submission. Internet self-response could also lead to the collection of more complete self-response for large households, and a potential increase in self-response from traditionally hard-to-count populations. Furthermore, Internet self-response can provide the capability to monitor data collection in almost real time and to gather information on the status of cases to facilitate case management.

4.249   As a starting point, the communications infrastructure and the level of use of the Internet in the community in general should be assessed to determine whether there is a possibility of providing Internet-based options in the field. Only where there is significant use of the Internet should any effort be made to put it into use for field operations purposes. On the basis of recent experience, it is recognized that if the Internet response option is not feasible or acceptable to the entire population, alternative modes of data collection need to be designed, along with the Internet self-response option. In most countries where Internet self-response has been implemented, the option was offered on the basis of voluntary

participation, which required effective methods of communication and contact with potential respondents to achieve the desired level of response rate.

4.250   Successful conduct of a cost-effective, large-scale, Internet self-response system requires developing, testing and refining business rules, requirements and assumptions for the data collection instrument. All systems developed to support Internet self-response must have the capacity to handle the expected response loads. Key to the success of this technology are the linkages between a centralized IT infrastructure responsible for the core functions of electronic data capture and transmission (to and from respondents), and the statistical expertise of the census agency managing the project. Another issue that needs to be considered is security of information transferred through the Internet.

4.251   To facilitate high rates of Internet self-response, planning and development activities need to focus on several areas, including:

(a) Optimizing the respondent experience by enhancing the usability, convenience and speed of the website;

(b) Developing effective communication and contact strategies to ensure that the expected number of respondents complete their census questionnaire online;

(c) Maximizing data quality through programmed edit checks and data validation;

(d) Making reasonable assumptions and projections regarding the level of response rate for the Internet self-response mode.

4.252   A decision is required on whether to administer Internet-based self-response by issuing unique census identifiers to households. An operation without unique identifiers could make it easy for respondents to respond anytime, anywhere to increase self-response rates. Where unique identifiers are implemented, households could use them to initiate their questionnaire or complete a questionnaire already in progress. In a multimodal census, the identifier is also used to track the completion status of a household. A household flagged as "non-visit" for face-to-face interviews may be placed into the field enumeration queue if self-enumeration is not completed within a preset amount of time.

4.253   Another consideration is whether the option to respond online will be available to those without personal Internet access. Through partnerships and other community-level efforts, free-standing or mobile devices could be made available for use by the public, and assistance could be provided to those who cannot complete the form themselves. Similarly, language needs must be addressed. The census agency must determine whether it will offer Internet questionnaires in multiple languages on the basis of national prevalence rates.

4.254   To attain a high response rate, Internet self-response operations should optimize the respondent experience. Due attention to the Internet form design could ensure a positive experience for users. The overall experience includes factors such as usability, convenience, speed, and the general "look and feel" of a website. To meet this broad range of expectations, respondents should be offered multiple avenues to complete their census online, including through a mobile phone application. The questionnaire website should be optimized for use

on mobile devices. This provides a higher level of convenience and ensures the broadest access possible to those without traditional Internet service. Internet questionnaire screens must be easy to complete and responses must be processed quickly to eliminate wait time between screens.

4.255   The development of optimal contact and communication strategies is critical for attaining a high response rate in Internet self-response operations. All attempts by the census agency to make direct contact with individual households for the purpose of encouraging them to complete their census questionnaire online are referred to as contact strategies. Multimodal contact strategies include the use of invitation letters, postcards and other publicity materials mailed to households; electronic correspondence (both email and text messages); and telephone calls. Each type or mode of contact may be used for multiple purposes: advance notification of upcoming contact, invitation to participate in the census online, remind prompting to non-responders, or completion of the questionnaire in an alternative mode.

4.256   The optimal combination of individual-level (for example, housing unit) contact strategies should be developed, tested and refined taking into consideration demographic, geographic, housing and economic variables to understand and plan for response propensities. Messaging strategies that are effective in motivating self-response should be developed in a similar manner.

4.257   Consideration should also be given to providing support to respondents in completing the electronic questionnaire. Support could be provided in a number of ways, including through instructional and help materials available and a call centre set up to assist respondents with any difficulties.

4.258   Box 28 presents an example from the Republic of Korea of self-enumeration using the Internet.

Box 28. Self-enumeration using the Internet: the experience of the Republic of Korea

Internet-based census data collection was first introduced in the Republic of Korea in 2005. With increasing awareness of respondents, participation in the Internet option is growing. The response rate reached 47.9 per cent in the 2010 census, while in the 2015 census a response rate of 48.6 per cent was recorded. The censuses first offered households the option to provide information through the Internet, and face-to-face interview was administered only to non-participating households. To increase the response rate, promotional activities were designed and implemented to encourage households to participate in the Internet survey.

Prerequisites for collecting population and housing census data via the Internet option

- Development of a reliable ICT infrastructure, with high a rate of Internet access coverage. In 2014, 81.6 per cent of all households in the Republic of Korea had access to the Internet.

- Generation of unique Internet access codes for households on the basis of the list of dwellings and households compiled prior to the census collection.

Benefits of Internet-based census data collection

- Cost savings are realized from reduced salary of enumerators, lower printing and handling costs of paper questionnaires, and other reduced expenses arising from the Internet-based data input system.

- Increased access to respondents, as the Internet self-response option enables respondents to participate in the survey easily when they have an available computer connected to the Internet regardless of the time and place.

- Lowering of the respondent burden, as the Internet self-response option alleviates concerns about breach of privacy.

- Improved data quality, as the range, consistency and relational checks of the data entry system have reduced the incidence of incorrect answers and improved the quality of the collected data.

Challenges of Internet-based census data collection

- Due to the proliferation of various web browsers and diverse versions of the web browsers, problems can arise from system errors.

- A contingency plan needs to be developed for system failures.

- The small-scale Internet access load tests showed no problems in the simulated systems; nevertheless, during the actual data collection phase where multiple Internet respondents were accessing the system, the increased access loads were not easy to manage and handle.

Lessons learned from the Internet survey option

- Increased awareness of respondents was noted. Respondents gradually accept that the Internet option is an easy and secure way to provide information, while avoiding the inconvenience of making themselves available to interviewers.

- Data quality is enhanced, as the data derived from the Internet survey are of better quality than those obtained via person-to-person interviews, thanks to the data checks and validation procedures.

- Development of a mobile survey input system is being planned. The Internet option implemented thus far was made available on desktop computers only, owing to the huge challenge of developing applications for various electronic devices while ensuring security. Utilizing lessons learned so far, serious consideration is being given to making the Internet option for the 2020 census available on mobile phones.

Source: Statistics Korea.

2.4   *Geographical information systems*

4.259   Geographical information systems (GIS) are typically used for creating digital maps on GPS-enabled handheld devices, as well as for producing paper maps. However, they are also increasingly being used in field enumeration operations to facilitate data collection and supervision of fieldwork. If buildings within each enumeration area have been identified and geocoded in prior geographical data collection exercises, the geographical coordinates can be

used by a navigation option built for the device to allow enumerators to reach households easily. GIS technology also offers the possibility to set up a system for real-time or rapid monitoring in the field. Where the survey collection and management system is integrated with GPS applications, each enumerator can tag an interview case with the respective enumeration area. This allows supervisors and managers to generate performance metrics and alerts associated with each enumeration area, helping them to identify and rectify problems quickly. GIS technology can also help in geofencing the handheld devices so that they will only allow an interview to begin when the device is located in the correct area for that enumerator. This ensures that enumerators are not capturing data outside the assigned boundaries. In places where prior geographical data collection exercises have not occurred, geographical coordinates can be captured during the field data collection operation itself. This offers the possibility of providing geocoded census results that can be aggregated to relevant geographical hierarchies.

4.260   An extensive elaboration on the use of both GIS and GPS is presented in Chapter III, section B.4, of the present handbook, and in the *Handbook on Geospatial Infrastructure in Support of Census Activities*.[70]

2.5   Call centres (contact centres)

4.261   A contact centre or call centre is an important element that can be used throughout the census process to support the field operations. Interactive voice response technology can be used to address the call to a specific agent on the basis of the options selected by the caller, or to resolve the call by providing a common answer. Website callback and chat can be implemented to help respondents to complete the online e-questionnaire in the portal, to verify information, and to confirm participation in self-enumeration Internet response.

2.6   Short messaging service

4.262   With mobile phone usage increasing dramatically in many countries around the world, SMS may be used in various stages of the census project. The service could be used to share information with field personnel, including sending guidelines, alerts or reminders. SMS text messaging from registered cellular phones assigned to census area supervisors can be integrated with the progress monitoring system designed to track the overall progress of data collection and field operations and to evaluate the completeness of coverage in each enumeration area while the enumeration is still going on. If the SMS gateway is integrated to the central database of the census, various alerts can be sent to the census management team upon various business critical events or when violations occur, for example when the monitoring system detects that coverage is lower than expected.

4.263   SMS text messaging can be a powerful supplementary tool for the publicity campaign. It can be used to improve participation in the census by sending reminders to the public. Collaboration with telecommunications companies to spread messages related to the

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[70] *Handbook on Geospatial Infrastructure in Support of Census Activities.*

census may be an effective and relatively inexpensive way of targeting the messaging at an individual level. It is of utmost importance to ensure that these bulk text messages are free to the receiver and that the fact that it is free is also known upfront. The publicity campaign should identify specific times and dates and develop specific messages to be distributed. For instance, a pre-enumeration message could alert people to the impending census date. Another message could be sent on the day enumeration starts to remind people that enumerators will be visiting their homes. If any special events or programmes are being organized to celebrate the census, a message about that may be appropriate to send to mobile phone users.

4.264   SMS-based applications also offer a way to supplement traditional methods of disseminating census results, allowing the data to be accessed by people who would normally have no direct access. Such a service could allow the public to make enquiries for specific census data via mobile phone text messaging.

2.7   Traditional information and communications technology

4.265   One service that is usually a key component of Internet services is email. This may be particularly useful for communicating with staff. In many cases, it is likely that field staff who have access to email will use it to communicate. If it is known that all field staff in a particular level of the hierarchy have access to email, it may be reasonable to include the use of email in the design of field operations. Again, there are cost issues that need to be taken into account, but it may prove a more cost-effective means of transferring information than telephone or fax.

4.266   While telephone use is commonplace in most countries, there are some countries, or areas within countries, where telephone access is limited. The situation in any given country will need to be taken into account when considering the use of telephones in field operations.

4.267   In many cases, using telephones to maintain regular communication between the various levels in the field structure will be the most practical and cost-effective method of monitoring and reporting. Accordingly, planning for census enumeration should specifically include the use of telephone communication. This can be documented in procedural manuals, which can provide guidelines on the frequency of calls. Quality assurance documentation containing checklists of items to be covered during telephone contact can also be included.

4.268   Telephone answering machines or voicemail services can also be considered. This is particularly useful during the enumeration activity, when the majority of staff will be away from a telephone for a large part of the time.

4.269   The fax is still used in some countries. It is relatively inexpensive and flexible in that it can be used to transmit a variety of reports or even copies of maps for updating. One advantage of using fax is that it is a written record. This is particularly useful for progress reporting or providing administrative data to different management levels. Standard documentation and control forms can be designed with fax transmission in mind. For

example, a simple control form can be used to record the payment details for a group of collectors and send the data to the census agency for input to the payment system.

4.270 Table 21 summarizes considerations to be taken into account when deploying digital technology for field operations.

Table 21

Considerations when deploying digital technology for field operations

Issue	Description
Skills	Are potential field staff likely to be computer literate? Can staff contribute to the development of advanced systems?
Facilities	Is the power supply inconsistent? Is off-site data storage available? What is the speed of the office Internet connection?
Hardware	Is desktop computing available at the central statistical office? In regional offices? Has data storage been centralized? Are centralized databases accessible internally? Externally?
Communications network	Does the telephone system in the country provide a reliable service across the country for computer-based transfer of data? Can the core infrastructure of the country support widespread connectivity? What is the likelihood that connectivity could adversely affect field operations?
Telephone lines	Will the statistical agency provide an additional telephone line exclusively for census use or subsidize the use of a manager's own private line? Will the statistical agency issue mobile phones?
Software	What software will be used? How will the software be designed? Will a special-purpose application be written? Will software development be outsourced? Will standard packages be used with the census agency providing templates set up for use in the field? What about the language support in case more than one language is needed?
Training	How will staff be trained? Is there adequate time to train on all of the skills necessary for successful deployment of the proposed system?
Data transfer	How will data be transferred between the census agency and field staff and vice versa? How will different versions and updates of the same data be managed?
Security	Are the data confidential, and if so, how will the data be secured?
Testing	How will the system be tested to ensure its viability? How much time will the completion of the questionnaire require?
Transport and return	How will the technology be delivered and returned?
Asset	How can the technology be used after the census? Can the hardware be used in the processing phase?

V. Data processing

A. Processing strategies

1. Introduction

5.1   The strategic directions for the data-processing phase need to be established early in the census cycle. The single most important decision regarding the processing phase is deciding on the processing system to be used and the technology that will be adopted.

5.2   This decision needs to be made early enough to allow sufficient time for testing and implementation of the processing system.

2. Planning for data processing

5.3   Of all the phases in the census cycle, the processing phase offers the greatest opportunity for the use of sophisticated technology. Rapidly emerging technology, such as data capture by handheld device, offers great potential and associated benefits for census-processing strategies. Issues associated with the use of particular technology are discussed in section E below.

5.4   The following key management issues need to be addressed:

(a) Strategic directions for the census programme;

(b) Technology infrastructure;

(c) Level of technical support available;

(d) Capacity of census agency staff;

(e) Technology used in previous censuses;

(f) Establishing the viability of the technology;

(g) Outsourcing of processing activities;

(h) Data security;

(i) Cost-benefit analysis.

Each of these issues is discussed in detail below.

2.1 Strategic directions for the census programme

5.5   The processing strategies that are adopted need to be considered with regard to the overall strategic directions that have been set for the census programme. These are often related to timeliness and cost; for example, the release of data nine months after census day or a reduction in costs of 5 per cent per capita of population, when compared with the previous census, would not be timely or cost-effective. The time and costs associated with the processing phase will have a large influence on achieving overall census timeliness and cost-effectiveness.

5.6　　Consideration may also be given to the corporate strategic directions of the census agency. This is because the adoption of new technology may have longer-term benefits for the census agency, such as acquiring hardware and software that can be used after the census and staff acquiring new skills that can be utilized in the continuing work programme of the agency.

2.2　　Technology infrastructure

5.7　　The establishment of sophisticated technology infrastructure within a census agency is a significant undertaking (see section E below). Certain types of technology, such as implementing an Internet-based census or other kind of digital census, may not be practical or possible in certain contexts or countries. As such, it is essential for the census plan to include sufficient time to test, install and configure new technology. The use of pilot exercises, pretests and small-scale trials will enable the systems to be optimized and adjusted prior to the actual census data processing.

2.3　　Level of technical support available

5.8　　If hardware or software are sourced from commercial vendors, the engineering and software support provided by these vendors is both necessary and critical. Before implementing any new technology, it is necessary to determine the level of support that is available for that particular technology within the country.

5.9　　This can be particularly important if the technology adopted is of a specialized nature. For instance, for some countries, a key consideration when implementing scanning technology is the availability of local maintenance and support capabilities. Owing to costs, some vendors may be reluctant to provide an extensive store of spare parts in the country and instead may rely on sourcing them from outside the country. They may also wish to provide software support through international help desks. However, census processing is subject to tight deadlines. Delays associated with a vendor being unable to procure spare parts in a timely manner may result in the census agency missing key project milestones and incurring additional costs.

5.10　　To minimize the effect of downtime on census-processing activities, some agencies have insisted that vendors provide on-site support at the processing centre for critical activities, such as data capture. This support may be in the form of an on-site engineer to maintain and service the equipment. Other support can include the provision of "hot spares", which are placed on site at the processing centre. These are complete units that are on standby and can be brought online quickly to replace units that fail. Other spare kits of parts should be ordered and placed on site at the processing centre. These spare kits are essential, especially if the equipment has been sourced internationally rather than locally.

2.4　　Capacity of census agency staff

5.11　　Related to the operation and maintenance of the system is the capability and experience of census agency staff. Existing data-processing staff may require additional

training or upgrading of skills, especially if new hardware or software systems are utilized in the census. Training of staff in the new technology should take place as early as possible so that those playing a role in processing the census can gain practical experience prior to the actual census. In some cases, it may be necessary to seek assistance from other countries or send key personnel to other countries for training.

5.12   Ideally, the selection of new technology for the census, and the subsequent training of staff, is done early enough for the census agency to test the technology on another statistical operation, such as a survey. This practical experience may prove to be the best training exercise for the data-processing staff and will enable them to make vital contributions during census planning and operation.

2.5   *Technology used in previous censuses*

5.13   In many countries, there are 10 years between censuses. Recent rapid advances in technology may mean that the technology used in a previous census is no longer the most appropriate technology for the census agency. However, this does not mean that this technology should necessarily be abandoned.

5.14   Significant resources may have been spent on establishing this technology and census agencies may wish to capitalize on that investment by reusing significant portions of the system. It may be decided that census agency resources are better utilized in other areas of the census programme (for example, migrating to GIS-based maps or establishing dissemination products). Reusing existing technology will be of more significance to countries that undertake censuses every five years. If particular systems are reused, they will still need to be rigorously retested before they are implemented in processing operations. Technology used in recent statistical surveys should also be considered in the context of the census.

5.15   There will also be cases where the adoption of new technology will not be cost-effective. For example, in countries where labour costs are low, the adoption of new technology such as scanning may prove to be more costly when compared with traditional key-from-paper systems.

2.6   *Establishing the viability of the technology*

5.16   During census planning, significant lead times should be allocated for the purpose of investigating and testing the viability of different technology.

5.17   A common and appropriate approach, undertaken by many countries, is the testing and implementing of new technology in other smaller statistical processing operations before the census. This has allowed agencies to become familiar with the technology and to solve operational problems before it is implemented in the census. Given the importance of the census and its infrequency, it is vital that agencies have a thorough understanding of the limitations of any new technology before implementing it in the census.

5.18   Regardless of whether an agency has experience with a particular technology, a rigorous testing programme has to be conducted before the census. This is because technology that is effective in one environment may not necessarily be effective in the different environment of a census. The testing programme can consist of the following:

(a) Small-scale and special-purpose tests that target particular components of the overall processing system (such as data capture, coding or editing), and which may also target particular problem areas from the previous census;

(b) Larger-scale tests that not only target individual components of the processing system but also test the integration of all of the component parts of the system.

5.19   The smaller-scale tests can use either contrived test data or data from any of the pilot tests conducted for the census. These tests can be designed to test the specific functionality and performance of particular components of the proposed processing system and should be undertaken first.

5.20   After the smaller-scale tests establish the viability of particular components, larger-scale tests should be conducted. The main aim of the larger-scale tests should be to test the integration of all components of the system. During these integration tests, it may be necessary to make changes to particular component parts of the system. In these cases, the complete system should be retested using the same data to measure the impact the changes have had.

5.21   The testing programme should also schedule a final processing test that imitates census conditions as closely as possible. This should be regarded as a dress rehearsal of census processing and should be conducted before census processing commences. While it is impossible to replicate the exact conditions of a census, it is important that volume testing that simulates the load and conditions of census processing also be undertaken. This testing should not use dummy data, but real data collected through the pilot census fieldwork.

2.7   *Outsourcing of processing activities*

5.22   While it is usually more efficient and cost-effective for census agencies to conduct the majority of processing activities, outsourcing some of the predominately IT-related operations may be considered. Outsourcing is the process of using a third party to undertake well-defined activities on behalf of the census agency. Outsourcing certain functions, such as activities that require specialist expertise that is not available within the census agency or the provision of specialized equipment that is only needed for the census and has no further subsequent use in the census agency, can be a strategic decision.

5.23   Outsourcing may be particularly relevant for specialized activities that use sophisticated technology, such as scanning and ICR for data capture or development of software for handheld data collection. This allows the managers of the processing centres to concentrate on the other core activities of processing. However, in these cases, managers will need to ensure that the activities that have been outsourced deliver the data quality specified. Managers will not need to be concerned with the finer details of the technology (that is, the

"how"), but will be concerned rather with the results (that is, the output). However, they will need a broad level of understanding of the technology in order to both specify the contract for outsourcing and manage that contract.

5.24   It is important to note that outsourcing does not transfer risk and all responsibility from the census agency to the contractor. In fact, outsourcing may bring new risk. Special attention will need to be paid to managing the contract owing to the loss of control that will result from outsourcing. This loss of control can have serious implications regarding the quality of data produced. Therefore, agencies should exercise extreme caution when outsourcing critical functions associated with processing. Some agencies have successfully outsourced contracts for census processing, but there are many more examples of failures. Details on managing outsourcing of contracts are contained in chapter II, section K.

2.8   Cost-benefit analysis

5.25   Apart from establishing the viability of new technology, research will also need to include a rigorous cost-benefit analysis. In the early stages of planning, it is likely that several strategies and solutions will be considered. Each should be compared using the same assumptions, which may include number of units to be processed, staff costs and so on. The cost-benefit analysis should include the following:

   (a) Capital cost of hardware, including spare parts;

   (b) Software licence and development costs;

   (c) Vendor support costs;

   (d) Training costs;

   (e) Salary costs for number of processors needed, which may vary for each strategy, depending on the amount of automation involved;

   (f) Benefits, which may include time needed to process the forms, and quality of the data produced;

   (g) Risks.

5.26   The majority of the inputs mentioned above are self-explanatory and do not need further discussion. However, because of the critical nature of census processing, it is worthwhile to expand on the identification of risks and managing these risks. It is important that all of the risks associated with particular technology be identified early and managed appropriately before, during and after implementation. The processes involved with identifying, analysing and responding to specific risks include the following:

   (a) Identifying the risk;

   (b) Quantifying the probability of each specific risk;

   (c) Quantifying the impact of the consequences of each risk;

   (d) Identifying risk mitigation strategies of each risk;

(e) Costing the risk mitigation strategies of each risk;

(f) Quantifying the probability of each risk after the risk mitigation strategy is in place;

(g) Quantifying the impact of the consequences of each risk after the risk mitigation strategy is in place.

B. Location of processing centres

1. Introduction

5.27   Census data processing often requires a large number of staff, equipment and space. It is essentially a factory operation, which, depending on the data capture method, often necessitates a purpose-built, or purpose-adapted, factory site.

5.28   It is unlikely that the staff needed to process the census will fit into the census agency's present accommodation. In many countries, the number of staff needed to process the census will be larger than the total number of staff in the census agency. Therefore, premises of a sufficient size need to be identified. Issues that need to be considered include: (a) the number of locations (centralized versus decentralized operations); and (b) the suitability of the premises.

2. Number of locations

5.29   Issues to be considered when deciding on the location and number of processing centres include the following:

(a) Method of data capture;

(b) Availability of skilled workforce;

(c) Availability of support services;

(d) Coordination of processing activities;

(e) Quality;

(f) Geographical location for delivery of forms;

(g) Dispersing infrastructure and skills throughout the country;

(h) Costs.

These issues are considered in more detail below.

2.1   Method of data capture

5.30   The method of data capture employed by the census agency will have a strong impact on the size and number of data-processing centres required to process census data. As a general rule, the more advanced the data capture technology, the less physical space required for the processing operation. For example, multiple locations may be required if census data are captured and coded in a traditional paper-based personal interview census. As indicated

above, this process requires hiring a large number of staff to complete the task. On the other hand, fewer staff and processing centres will be required if the census agency captures census data through the Internet. In this instance, a number of tasks, such as coding and capturing data, are completed by the respondent. For more information on data capture methodologies, see section E below.

2.2   *Availability of skilled workforce*

5.31   Processing centres will need to be located in areas where there are a large number of potential workers who have the required skills and are available for processing data. This will usually mean that the centres will be located in large urban areas. The processing centres should be located at sites within these urban areas that allow staff easy access to public transportation facilities.

2.3   *Availability of support services*

5.32   The activities at the processing centre rely on many support services, which may be provided by staff from the census agency or other external providers. These may include specialist subject matter support (for example, classification experts from the census agency), IT support and other administrative support services. All of these support services should be available in the locations selected. The number of processing centres may have an impact on the level of support that is available from these groups. It should be noted that, during census processing, some of the support staff from the census agency will also have commitments to the continuing work programme of that agency.

2.4   *Coordination of processing activities*

5.33   Coordination of overall national processing will be needed with multiple locations. The appointment of a national operations manager will assist in these coordination activities.

5.34   Each centre should be properly resourced to meet the processing timetables. In some circumstances, it may be necessary to add resources to particular centres if they are experiencing unforeseen difficulties. Reallocation of resources is much easier in a centralized scenario, as these resources can be more easily transferred between processes to overcome temporary difficulties.

2.5   *Quality*

5.35   The most common argument against decentralizing processing to a number of locations is the risk to the quality of census data owing to a lack of consistency in processing between centres. This can occur when managers or staff in different centres interpret or implement procedures differently.

5.36   If multiple centres are used, particular attention should be paid to implementing consistent quality assurance procedures across all centres. In these cases, it is essential to maintain open and regular communication channels between the centres. Any proposed changes to procedures or processing systems should be carefully coordinated with all centres.

The appointment of a national quality assurance manager who is responsible for monitoring the quality of data produced in each centre will assist in coordinating these tasks among all centres.

2.6 *Geographical location for the delivery of forms*

5.37   If a centralized processing centre is used, it may be beneficial to locate it near the main centre of population within a country. This would mean that a large proportion of forms would only have to be transported relatively short distances. It would also be expected that this location would have the most suitable transportation access from most regional areas. However, with decentralization to a number of regional centres, transportation costs may be significantly reduced.

5.38   Another advantage of decentralized locations is that the staff employed at these centres have knowledge of their locality, which may be beneficial. For example, locally engaged staff may have a better knowledge of local industries and occupations, which can be utilized in the coding process. However, care needs to be taken that these staff do not rely too much on local knowledge and regard themselves as experts, disregarding established standardized coding procedures.

2.7 *Dispersing infrastructure and skills throughout the country*

5.39   A decision may be made to decentralize to a number of centres in order to take the opportunity to provide both infrastructure and skills to various parts of the country. This is a strategic decision, and the capabilities of the proposed regions need to be considered. While the census provides such opportunities, it should not be regarded as a training exercise and the staff in these regions must be capable of undertaking the processing activities to the agreed quality standards.

2.8 *Costs*

5.40   During the search for suitable data-processing premises, the census agency should give priority to sites already owned by the agency or its parent department. If these institutions do not have access to suitable locations, then the agency should consider other government-owned sites prior to considering the commercial market. Identifying appropriate premises that are owned by the Government may result in substantial savings.

5.41   If buildings are sought in the commercial market, rental costs will usually be higher for a short-term tenancy than for a longer period. In general, the costs associated with decentralized operations may be higher than those for centralized ones because of the diseconomies of scale associated with duplication of support services.

5.42   If it is determined that multiple data-processing centres are required, then additional consideration must be given to how best to configure the responsibilities of the centres. While there is no prescribed best practice, countries usually divide responsibilities between the centres in one of two ways. Some countries decide to have each of the data-processing

centres conduct all of the required processing activities (such as coding and capture) for their particular region. Other countries divide the responsibilities of the centres by the particular process. For instance, one data-processing centre may be responsible for coding the required variables, while another data-processing centre is responsible for the data capture operation.

3. Selecting suitable premises

5.43   Obtaining available premises to house census-processing activities may not be straightforward. The fact that the premises may only be required for a relatively short period of time can restrict the choice of premises. In some countries, other government agencies may have established infrastructure that can be utilized for census processing. In other circumstances, premises may need to be obtained through commercial markets. Some of the factors to consider when selecting premises for processing include:

(a) Security;

(b) Access for transportation;

(c) Building layout.

3.1   Security

5.44   The security of the census data is necessary owing to the confidential nature of the information on the forms and the assurances given to the public about protecting their personal information. Therefore, security issues must be considered during the selection of a building and not as an afterthought. It is difficult and expensive to protect against determined breaches of security and, in reality, no building that houses staff can be made totally secure from the removal of confidential information. The perception that adequate security provisions have been put in place can be equally as important as the actual provisions themselves.

5.45   Dual or multi-tenancy buildings provide a risk to security, especially where entry and exit routes such as loading docks, stairs and lifts are shared; in this regard, single-occupancy premises are preferred. In single-occupancy premises, the number of entry and exit points should be kept to a minimum. Clearly, staff access is an issue, but as long as staff are able to enter and exit the building without undue delay, fewer entry points will provide for better security control.

5.46   A combination of both electronic and physical security can be implemented. With the technological advancement in recent years, electronic surveillance has become more financially viable and an extremely effective option, even for short-term projects such as census processing. The presence of physical security in the form of security guards not only covers the issue of perception of security discussed earlier, but is also effective in the important aspect of creating security consciousness in the minds of employees.

3.2 *Access for transportation*

5.47   While not an overriding issue, suitable access for transport to deliver the forms or devices may be important in some countries. If large road transport vehicles are used to transport the forms, easy access to the premises will be required. This will be particularly important if the processing is centralized in one location where large volumes of materials will need to be processed.

3.3 *Building layout*

5.48   Because of the large volume of census forms and materials, premises should contain a combination of office accommodation for staff and storage areas for the materials. It is preferable that single premises be used for both the storage and scanning of forms. This will enable a more efficient movement of material throughout the processing centre. The storage of material nearby but in another building will involve additional handling costs and the potential for forms to be damaged, as well as introducing security risks. There will also be economies of scale with single premises in regard to both rental cost and security.

5.49   Special attention should be paid to estimating the space required for the storage of material and for the efficient flow of forms throughout the building to reduce bottlenecks. For example, sufficient space should be provided in the office accommodation for the storage of workloads that the processors are currently working on. If this is not the case, the workloads will have to be returned to a central storage area at the end of each shift. This would create a bottleneck and lost production at the beginning of each shift, as processors would have to retrieve their workloads from a central point.

5.50   While storage of some material within the office accommodation is required, it must be remembered that the majority of material should be stored in designated storage areas and not in the office accommodation. Excess amounts of material in the office accommodation can create occupational workplace hazards and restrict the design of workplace configurations. Material can be transferred from specifically designed storage areas to the office accommodation only when it is needed for processing. Efficient flow control systems to control the movement of forms are discussed in section D below.

5.51   The design of the office accommodation will need careful planning not only to ensure that material can flow efficiently but also to take into account occupational health and safety issues. For example, several desks can be grouped together in a way that will allow the computer cables to be hidden between the desks rather than running across walkways and corridors.

C.   Establishing the workforce structure and recruiting staff

1.   Introduction

5.52   Issues associated with recruiting staff for the processing phase are in some ways similar to those associated with recruiting staff for the field operations phase. This is

especially the case when the census agency uses handheld devices to capture census data, as the enumerator has the responsibility of completing the fieldwork and data capture operations. The aim of a successful large-scale recruitment campaign for processing should be to recruit the best-quality staff from those available, within the time allocated and within budget.

2.   Establishing the workforce structure

5.53   Prior to planning a recruitment campaign, it is necessary to establish the workforce structure at the processing centres. It is not possible to be prescriptive about what structures should be put in place at a processing centre, as this will largely depend on the processing strategy, technology used, number of staff employed (see section 3 below) and the local conditions in a country. For the purpose of the present handbook, the discussion below will focus on a workforce for manual or optical scanning data capture methodologies, as these remain the most common methodologies utilized.

5.54   If processing is decentralized to a number of locations, the structures can also vary according to the tasks carried out at each centre. For example, one centre may be responsible for a particular process (such as data capture), with other processes (such as coding) conducted at different centres. In other cases, multiple processing centres may be established throughout the country that are responsible for the complete processing of data for the surrounding regions.

5.55   A generic management structure is illustrated in figure XI. This structure is based on the assumption that there is one processing centre that carries out all tasks associated with the processing phase. Countries will need to adapt this to suit their own conditions. The roles and responsibilities of each level in the generic structure are also discussed below.

Figure XI

Example of a data-processing senior management structure
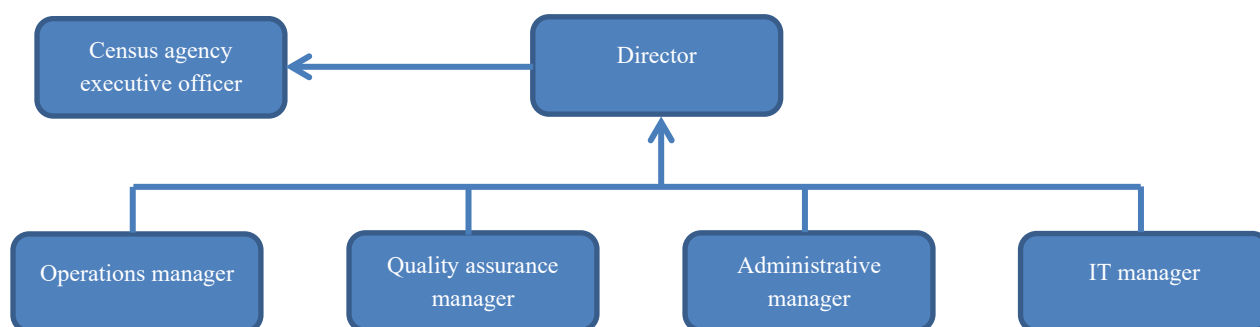
5.56   In this structure, the director of the processing centre reports directly to the executive officer in the central census agency. If processing is decentralized to a number of centres, an additional layer of management may be needed to coordinate and monitor the activities of each processing centre and report to the census agency executive officer.

5.57   Managers, who are accountable for broad areas of responsibility, report to the director of the processing centre. The areas and associated responsibilities are shown in table 22.

Table 22

Data-processing centre responsibilities

Areas	Responsibilities
Operations	Day-to-day operations of form processing. Includes all the main processing tasks, such as variable coding, data capture and the coordination of workflows. The operations manager is responsible for ensuring that timetables are met.
Quality assurance	Monitoring and control of quality assurance systems and procedures, including edits. The quality assurance manager is responsible for ensuring that the data meet all quality standards.
Administration	Supporting the processing centre with all administrative matters, including facility management, recruitment, payroll services, purchasing and budget monitoring. The administrative manager is responsible for the provision of efficient and effective support services.
Information technology	Supporting the processing centre with all IT matters, including communication networks, hardware and software installation, and maintenance. The IT manager is responsible for the maintenance and support of all IT infrastructure.

5.58   An important point to note in this generic top-level structure is that one position has been allocated for operations and one position for quality assurance. Allocating separate responsibility to these tasks at this level in the structure reflects the need for these important aspects of processing to be managed by separate positions. Agencies that have successfully adopted this practice have proved that there are great benefits in adopting such a model.

5.59   Quality assurance managers will be able to devote all of their time to ensuring that the quality of the data meets the agreed minimum standards, without the pressures of day-to-day operational control. Operational managers will similarly be able to devote all of their time to coordinating the workflow and ensuring that timetables are met. Depending on the size of the processing centre, the operations manager may need assistance from additional deputy managers at the middle management level. However, the important point is that there is a single position in the management hierarchy that is ultimately responsible for all operational tasks.

5.60   Adopting this management model during processing operations may lead to conflicting opinions regarding the different components of overall data quality (timeliness, cost-effectiveness and data accuracy). For example, the quality assurance manager may recommend that additional procedures are implemented to rectify deficiencies in a particular process that are causing problems with the accuracy of the data. The operations manager will

be responsible for assessing the impact that these procedures may have on timeliness and cost. The director will be responsible for resolving conflicts and establishing a balance between quality criteria, and must do so with regard to the strategic directions set for the processing centre.

5.61   Below this top-level structure, there may be another level of middle managers. The number of levels of middle management will depend on the size of the processing centre and the complexity of the processing methodology adopted. These middle managers will be responsible for several teams of staff that comprise a supervisor and several processors. An example is shown in figure XII.

5.62   The ratio of supervisors to deputy managers, and processors to supervisors, will vary according to the processing methodology used and the number of staff employed. However, special attention should be paid to establishing the ratio of processors to supervisors. The number of processors in these teams should be limited so that an effective team environment can be established and the supervisor has adequate time to pay close attention to all staff. As an example, some agencies have established ratios of approximately 15 processors per supervisor.

Figure XII

Example of a data-processing middle management structure
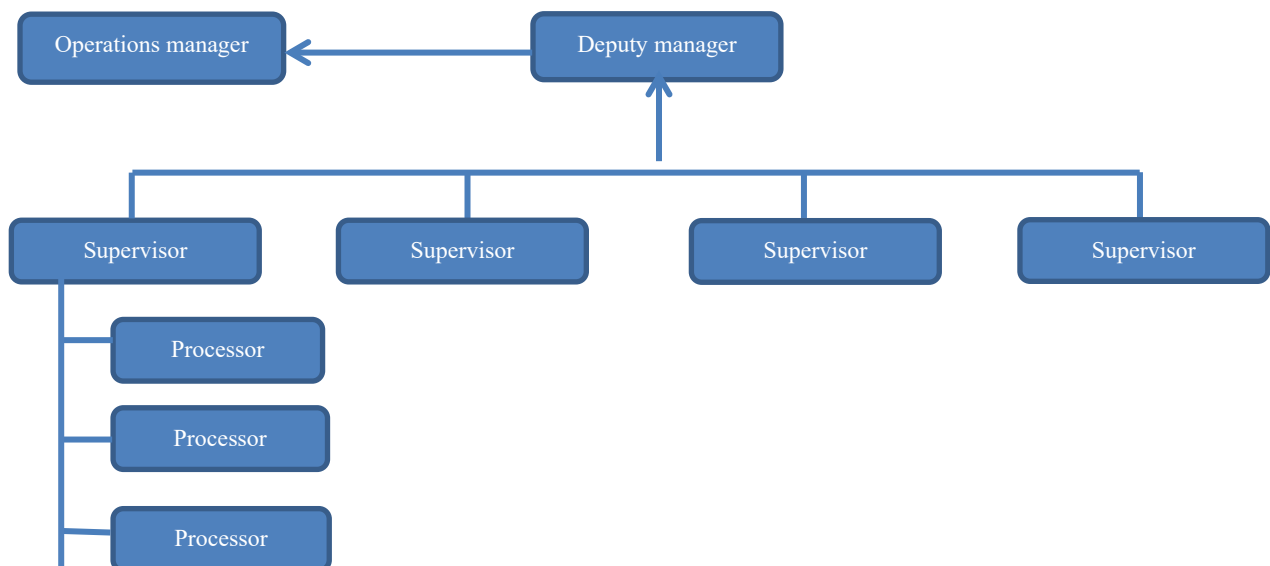
5.63   Supervisors are a key link in the management structure and communication chain and represent a single point of responsibility. They are usually temporary staff and form the link between management, who are generally census agency staff, and the bulk of the temporary processing staff who are undertaking the processing tasks. Because of their importance in the structure it is worthwhile discussing their tasks and responsibilities. These can include the following:

(a) Conduct day-to-day supervision of a team of processors;

(b) Prioritize, coordinate and monitor the workflow;

(c) Maintain an effective team environment;

(d) Conduct on-the-job training;

(e) Ensure that all procedures are being followed;

(f) Provide performance feedback to processors;

(g) Report to management on issues affecting data quality and any other issues they should be aware of;

(h) Coordinate with the storage room.

5.64   In addition to supervisors, group leaders can also be engaged in the following activities:

(a) Provide performance and daily production reports to the supervisor;

(b) Assist processors with technical issues;

(c) Provide processors with all needed materials and questionnaires;

(d) Check-in and check-out of questionnaires with the storage room.

3.   Estimating staff numbers

5.65   The strategies adopted for the recruitment campaign, and the management structure, will largely depend on the number of staff required at each processing centre. Therefore, the first step should be to estimate the number of staff required to complete processing in the time frame specified. As mentioned above, the number of staff required will largely depend on the data capture method selected.

5.66   In general, the number of staff required can be calculated using the following model:

(a) Estimate of total number of units (for example, persons and enumeration areas) to be processed;

(b) Estimate of total number of units to be processed for each unique topic;

(c) Average production rates (units processed per hour) per processor;

(d) Average processing hours per shift per processor;

(e) Number of shifts per day;

(f) An allowance for public holidays and staff taking leave;

(g) Estimated staff turnover;

(h) Facility capacity;

(i) Length of time for processing.

3.1   Total number of units

5.67   The total number of units to be processed can be derived from a variety of sources. The total number of enumeration areas or dwellings may be available from the mapping and listing process for the current census. The estimated number of persons may be available from current population estimates that are based on the previous census.

3.2   Total number of units per topic

5.68   Not all questions on the census form will be processed for each person enumerated. For example, only those persons in the labour force will need industry and occupation fields coded; some questions may only relate to females 15 years of age and older (for example, fertility questions).

5.69   Therefore, estimates on data entry and coding actions required can be made for each topic, on the basis of estimates of such variables as labour force participation rates or number of females over 15 years of age.

3.3   Average production rates

5.70   Sources for this variable can be the results from the previous census or any processing pilot tests that are conducted for the current census. If data are not available from these sources, it is possible to draw on the experiences of other national census agencies that have similar conditions. For example, for key-entry systems, an overall average of 6,000 keystrokes per hour is a realistic estimate.

5.71   It is important that realistic estimates be made for this variable and, where possible, that they be based on quantitative data from previous experiences. This is because salary costs for processing are generally a large component of the overall census budget. Discrepancies between these estimates and the rates actually achieved during production can have an important impact on the overall census budget. Management tools such as the performance evaluation and review technique (PERT) could be used to estimate these rates.

5.72   An allowance must also be made for the expected learning curve of processors. As processing continues, staff will become more proficient and therefore production rates will rise. The steepness and length of the learning curve (that is, the time it takes for processors to reach peak efficiency) largely depend on the particular process, the technology used and the quality of staff recruited. In some simple processes, staff may reach peak efficiency in a short period of time, whereas for more complex processes, the learning curve can be spread over several months.

5.73   It should also be recognized that the actual form design could dramatically affect the production rates that can be achieved. It is therefore important that managers responsible for processing have an input into the form design process.

3.4   *Average processing hours per shift*

5.74   It is important to estimate the processing hours achievable in a single shift. It is unreasonable to expect that a person employed for an eight-hour shift will be able to deliver eight hours of processing. Allowances must be made for time spent in meetings, training programmes, work breaks and so on. The amount of time allowed for this will vary depending on a country's particular circumstances, but it is important to factor unproductive time into the equation. In some countries, this time can comprise approximately 25 per cent of the total shift hours (so that six processing hours can be achieved in one eight-hour shift).

5.75   Allowances should also be made for the total amount of time processors will spend on quality assurance tasks. Some countries allocate an overall 10 per cent of processors' time for these tasks. This percentage will vary over the life cycle of the processing phase and should be built into the model.

3.5   *Number of shifts per day*

5.76   Many countries may use more than one shift in a day. Using multiple shifts can assist in reducing capital costs associated with equipment purchases and reduce the total time needed to process the census. If multiple shifts are adopted, adequate time should be allowed between the shifts to avoid congestion.

3.6   *Public holidays and leave*

5.77   Public holidays are easier to allow for, as they are generally known. However, calculating an allowance for staff taking leave is more problematic. Again, this will largely depend on the particular conditions of service the staff are employed under and the country's particular circumstances. Experience has shown that when temporary staff are engaged to process the census and they have access to leave provisions (such as paid sick leave or other leave), they will generally avail themselves of these provisions. The experience of previous processing centres will provide a good guide as to the expected trend.

3.7   *Staff turnover*

5.78   The prevailing economic climate in a country will directly affect both the quality of staff available and staff turnover. The economic climate will differ markedly over time and from one country to another (and even between regions in a country), and therefore staff turnover may or may not be a significant issue. Countries will have to assess the significance of staff turnover when estimating staff numbers.

5.79   The majority of positions (often greater than 90 per cent) at a processing centre are usually short-term temporary ones, with relatively low remuneration attached to them. Therefore, in times of economic growth, with the job market flourishing and low unemployment, a census-processing centre is more likely to be seriously affected by a high turnover of staff. Conversely, with an economy contracting and alternative jobs difficult to find, the processing centre will experience a more stable employment base.

5.80   Costs attributable to high staff turnover, which may be hidden in large organizations, are magnified in a short-term project, with a fixed budget and deadlines.

5.81   A booming economy and high turnover of staff is likely to result in:

(a) Loss of the best-quality staff first;

(b) Additional recruitment costs and delays;

(c) Additional training costs for replacement staff;

(d) Learning curves for new staff, reducing production rates and quality of work overall;

(e) Management focus on training rather than on production;

(f) Possible greater utilization of leave credits.

3.8   Facility capacity

5.82   The capacity of the buildings selected to house processing staff may be a constraint on the number of staff that can be employed. Ideally, buildings with sufficient capacity will be sought after the required staffing numbers have been established, but this is not always possible.

3.9   Length of time for processing

5.83   The length of time for processing can be either a constraint (for example, processing must be completed by a certain date) or a variable (for example, the building capacity allows for x number of staff and therefore processing will be completed on a certain date). However, in general, the length of time for processing will be a constraint. It is usually set as a goal in the census-planning phase.

5.84   Once staffing numbers have been calculated, recruitment of staff can be divided into two streams. The first task should be to recruit the managers and the second to recruit the bulk of the processing staff.

4.   Recruiting managers

5.85   Managerial positions are more specialized and fewer in number than the bulk of processing staff and therefore can be recruited through a different campaign. In the majority of countries, the senior managers of a processing centre will be recruited from census agency staff. In these cases, agencies can adopt their traditional recruitment methods.

5.86   It is essential to have managerial staff from the census agency at the processing centres, as they will have an expert knowledge of the processing systems and procedures that have been developed. They will also be aware of the dependencies associated with the processing phase, the overall census goals, and how the processing phase will contribute to these goals. They will also understand the data and the core business of the census agency. It is also highly desirable to recruit capable staff who have experience in processing operations, as their knowledge and experience of operational work is a valuable asset.

5.87   However, agencies should note that the environment at a processing centre is generally quite different from that in the census agency. It is operational and in the beginning is often described as "organized chaos". Therefore, to ensure that this chaos is indeed organized, it is important that the senior managers at the processing centre be aware of the different operational nature of the processing centre and that they be suited to this environment.

5.88   The number of subordinate staff a manager in a processing centre will usually supervise is higher than in the census agency. Therefore, the supervisory role of the manager becomes far more important.

5.89   A predominantly temporary workforce, many of whom may have been previously unemployed, can draw together a wide range of social and economic backgrounds. This environment is therefore likely to have a more volatile and socially unstable employee base than that of a more permanent workforce, where staff have security of tenure and a consistent source of income. In particular, managers must have good people skills in addition to statistical knowledge.

5.90   It should not be assumed that statistical experts who have worked on the development phases of a census can easily transfer to a staff management position and cope with people skills as a matter of course. While there may be numerous census agency staff who are capable of adapting to the alternative role, the fact that good staff management skills are not easily attained and are crucial to the success of the processing centre should be kept in mind.

5.91   Managers will need to fully understand, and have a commitment to, the quality assurance principles adopted for the processing centre. They will also need to have the ability to instil this commitment in the staff they will manage.

5.92   A successful strategy for recruiting managers in a processing centre will require striking the right balance between retaining current technical knowledge, providing developmental opportunities for employees of the census agency, and searching, often externally, for staff with people management expertise.

5.   Recruiting supervisors and processors

5.93   These levels in the workforce structure comprise the largest number of staff and they will generally be recruited on a temporary basis. Therefore, the recruitment of these staff may require different strategies from those used in recruiting the managerial staff. Strategies that may be adopted include the following:

   (a) Agencies conducting their own recruitment campaign;

   (b) Using other specialist government employment agencies;

   (c) Outsourcing to private sector recruitment agencies, if they exist and they have access to resources.

5.1 *Agencies conducting their own campaign*

5.94   The option of agencies conducting their own recruitment campaign may be regarded as the easiest and most cost-effective one. However, there are a number of issues that should be considered that could outweigh any expected savings. These include the following.

(a) Bulk recruitment of this order of magnitude is usually not a core function of a census agency. Although there may be officers within the agency who perform the task on a small scale, it is unlikely that they would have the required expertise for large-scale recruitment.

(b) The timing of the task is far from ideal, given that any recruitment strategy would have to be aimed as close to commencement of processing as possible in order to reduce the dropout numbers. It would therefore coincide with other major preparatory tasks that may require the focus of management.

(c) Depending on the economic situation at the time, a large-scale recruitment exercise could require significant infrastructure to cater for a possible flood of enquiries and applications.

5.95   If an agency chooses to conduct its own recruitment campaign, it will have to decide to what lengths it wishes to go to secure suitable staff. There is a large amount of reference documentation and assessment techniques relating to the general process of selecting staff. However, few of these are applicable when discussing the placement of a large number of short-term staff within a very short period. Therefore, the ideal results may not be achievable within the available time frame and budget. It is therefore important to determine the essential criteria to be met by prospective applicants.

5.96   One of the simpler and more cost-effective options for determining suitability for a position in a processing centre is the application of a short selection test. This test can be designed to evaluate those attributes that are deemed most applicable to the duties involved. These attributes may include the following:

(a) Aptitude for the repetitive clerical tasks to be performed;

(b) Accuracy in performing this type of work;

(c) Comprehension of written material;

(d) Speed in performing tasks, without loss of accuracy.

5.97   A short, multiple-choice explanation that tests the above criteria can prove a valuable guide to an applicant's suitability. While some basic infrastructure will be needed to conduct these tests, this should be available in the processing centres that are being established to process the census.

5.98   The results of these tests can be used to establish a ranking of applicants, which can be used as the order in which applicants will be offered employment. This list can also be

used for contingency purposes (see section C.8 below) to replace processing staff, if necessary.

5.99 It may also be useful to confirm applicants' suitability to the positions through conducting short interviews, during which each applicant is asked a standard set of questions. At these interviews, applicants should be given complete information about the position, the tasks to be performed and the performance standards required. Undertaking a large number of interviews over a short period of time can be physically and mentally demanding for the interviewing staff. Therefore, careful management of this workload is required.

5.2 Using specialist government employment agencies

5.100 Whether these agencies exist and are an option will largely depend on the circumstances in a country. If such agencies do exist, their expertise and permanent infrastructure can be used effectively. This may prove to be more cost-effective than the census agency establishing the infrastructure for an exercise that is not often repeated.

5.101 However, the current trend in many countries is for such government agencies to operate on a cost-recovery basis. Therefore, the savings that may accrue in direct costs by using these agencies may not be a significant factor. Other considerations, such as lessening the burden on managers at the processing centre, may make using these other government agencies an attractive option.

5.3 Outsourcing to private sector recruitment agencies

5.102 In some countries, private sector recruitment agencies offer similar services to those of government agencies, although at a cost that is sometimes prohibitive for the recruitment of large numbers of staff. Census agencies need to ensure that the selected private sector agency understands, and will implement, their requirements. It is possible that a for-profit organization may have a conflict of interest in that there could be a desire to place persons from its existing lists who may not necessarily be the most suitable applicants.

5.103 The principles regarding selecting and managing contracts in outsourcing are covered in chapter II, section B.

6. Recruiting other specialist staff

5.104 Apart from managers, supervisors and processors, there may be a need to recruit specialist staff for particular functions at the processing centre. These staff can include:

    (a) Specialist IT staff;

    (b) Specialist administrative staff;

    (c) Store persons for the movement of material;

    (d) Support services staff (for example, for maintenance, security and cleaning).

5.105 If these staff perform functions that are not part of the core business of the census agency, these functions may be outsourced to other agencies or private companies. In other

cases, separate recruitment campaigns may be needed because of the specialist nature of these staff.

7. Timing of recruitment campaign

5.106   As with all recruitment campaigns, it should be conducted as close as possible to the time when people are required to commence work. This will lessen the impact of applicants not accepting the job offer because they have found alternative employment or lost interest in the position.

5.107   All positions in the processing centre can be filled on a cascading principle from the top down. This means that senior managers are recruited first, followed by middle management, supervisors and, finally, processors. Specialist staff mentioned in section C.6 above will be recruited as they are needed. This will enable the senior and middle managers to be involved in the selection process of their staff if this is undertaken by the processing centre. It will also allow time for the staff at the managerial level to receive training before the supervisors commence work, and for the supervisors to be trained before the processing staff begin.

5.108   Processing centres that contain large numbers of staff may also need to stagger their intake of staff over several weeks. This is because of the logistic problems associated with processing and training large intakes of staff at one time.

8. Contingency planning

5.109   An important issue that is often overlooked when considering recruitment strategies is contingency planning. If staff turnover becomes a significant factor, which would not be unreasonable to expect in a temporary workforce (especially in boom times), and this turnover exceeds expected natural attrition, there will be a need to recruit additional staff. The alternative would be an extension of the processing timetable.

5.110   Any recruitment campaign has to include a contingency factor whereby the addition of staffing levels can occur efficiently, quickly and with little additional expense.

9. Remuneration

5.111   The remuneration paid to staff will affect the number and quality of staff who will apply for these positions. As far as possible, remuneration should be in comparison with market rates for broadly similar jobs. However, agencies should be aware that, in many cases, government rates will be below market rates.

5.112   Remuneration can be in either of two forms:

   (a) Set wage rates by the individual, subject to quality;

   (b) Payment based on the number of units processed (piece rates).

5.113   Adopting set wage rates results in less administrative overhead and does not promote a production line mentality, whereby staff focus on production rather than quality. Some

countries that have adopted set wage rates have also implemented small performance bonuses, which can include time off or extra holidays. These bonuses are given to staff who are performing at or above an agreed minimum standard. It provides a small incentive for staff and rewards those staff with superior performance. It may also assist in retaining good-quality staff.

5.114   Payment based on units produced has the advantage of only paying for actual work completed. Estimating processing costs for budget purposes can also be simpler. This is because it is generally easier to forecast numbers of units to be processed than production rates. However, a major disadvantage is that staff can become focused on production and disregard the quality of the work they produce. This can have negative implications for the quality of data produced. The complexities associated with this scheme can also make it difficult to administer.

D.   Processing operations

1.   Introduction

5.115   Operations at the processing centres need to be carefully managed in order to achieve a successful outcome for this phase of the census. The quality of the staff employed at the processing centres will have an important impact on the success of the processing operations. In particular, the quality of the staff employed as managers of the processing centres, and the management tools they are provided with, are critical to the success of the processing operations.

5.116   Adequate management structures (see section C above) will need to be put in place in order to coordinate and control all of the activities involved in processing.

2.   Data-processing cycle

5.117   The data-processing cycle involves many different interdependent activities. Figure XIII, and the ensuing discussion, detail the major activities that comprise a census-processing system for paper-based censuses. The number and nature of these activities will largely depend on the technology used to process the census forms (see section F below). For instance, if handheld devices are used, the coding activity for certain variables may take place during enumeration. It is beyond the scope of the present handbook to discuss, in detail, the cycle for each technological option for census processing.

5.118   As seen in figure XIII, the processing phase is a client area of the enumeration phase and, as such, relies on the quality of the output from that phase. The dissemination phase is the major client area of the output from the processing phase and, again, relies on the quality of the output produced by the processing system.

Figure XIII

Data-processing cycle for paper-based censuses
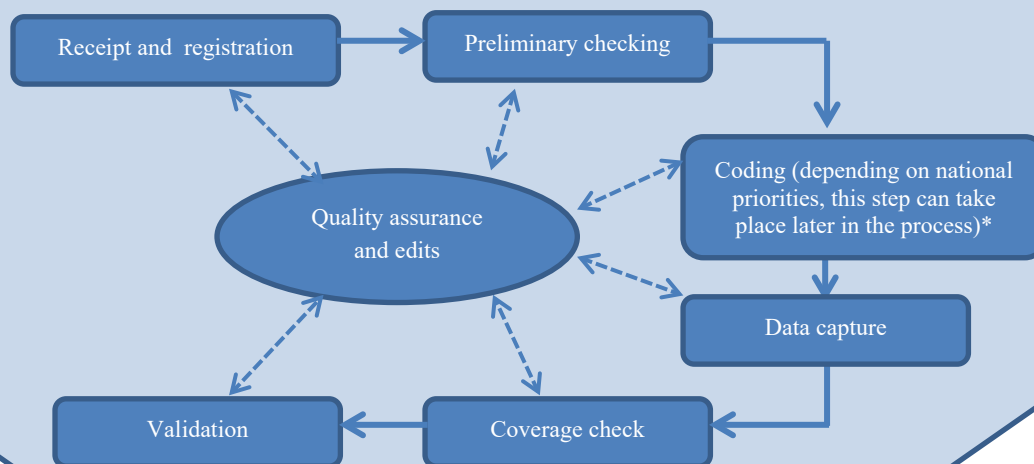
Note: In some countries, the coding of write-in responses is done through a combination of automated means (autocoding) and manual coding of cases failing the automated process. In this approach the coding is done following the data capture step. The write-in responses are coded by means of algorithms that use reference files. The rate of automated coding is a result of the algorithm's level of sophistication (direct matching versus fuzzy matching) and the quality of the reference files employed.

5.119   The quality and quantity of output from each activity in the processing cycle has a direct effect on the success of the next activity and other activities downstream. It is also important to note that, in this example, all activities interact with one another through continuing quality assurance. This can become evident at any stage. For example, the staff

undertaking validation may detect problems that are the result of inadequate procedures or training in one of the preceding activities (for example, receipt and registration).

5.120   While data processing can largely be regarded as a linear cycle, all activities will usually be concurrent. Initial activities for paper-based enumeration, such as receipt and registration, will commence first, but the other activities will commence shortly thereafter as soon as sufficient workloads have been completed by the initial activities. It is important that the flow of forms between activities be managed and coordinated carefully to ensure that each activity has sufficient forms for all staff. A buffer or backlog of forms should be established between each activity (for example, two weeks of work), which will ensure that staff do not run out of forms to process. For example, using the system shown in figure XIII, the data capture activity should not commence until there are sufficient numbers of forms for two weeks of processing. If it takes one week for this amount of forms to be processed by all of the activities before data capture, then data capture would not commence until the third week.

2.1   Quality assurance and edits

5.121   These strategies are discussed in detail in section E below. However, it is worthwhile to consider their relationship to all other activities in the processing cycle. As can be seen from the above figure, quality assurance and edits can be regarded as the core of the processing cycle and are critical to producing high-quality data. They ensure that the output from each activity is of the required quality for the next activity and provide a mechanism whereby appropriate feedback is delivered to all activities.

2.2   Receipt and registration

5.122   As forms or records (in case mobile devices are used) are received at the processing centres, they should be registered to ensure that all enumeration areas in the country and all households within each enumeration area are accounted for.

5.123   The managers of this activity will be required to closely coordinate their work with managers in the field operations phase. They will need to monitor the deliveries from the field to ensure that material flows smoothly, with minimal delays or congestion.

2.3   Preliminary checking

5.124   Regardless of the technology employed to process paper forms, some type of grooming of the forms will be necessary. The extent of grooming can vary from superficial checks to ensure that the forms are in adequate condition to be read by scanners to transcription of damaged forms and manual editing of responses.

2.4   Coding

5.125   Coding assigns classification codes to responses on the census form. Coding can be an automated system, computer assisted, clerical, or a combination of all three.

2.5   *Data capture*

5.126   In paper-based censuses, data capture refers to the system used to capture information from the census form and create a computer data file. These systems could include:

(a) Manual key from paper;

(b) Manual key from image;

(c) Optical mark recognition (OMR);

(d) Intelligent character recognition (ICR);

(e) Handheld electronic device (such as tablet, laptop, PDA);

(f) Telephone and Internet.

5.127   A detailed discussion of the various systems that can be used for data capture is included in section E.3 below.

2.6   *Coverage check*

5.128   The coverage check, also referred to as balancing, refers to a system to ensure that a computer record has been created for every enumeration area, every household within each enumeration area, and every person within those households.

2.7   *Validation*

5.129   Validation is the final check of data to ensure that the quality of the data meets agreed minimum standards (see section F.7 below for further details). Where standards are not met, it may be necessary to repeat previous steps.

3.   Controlling workflows

5.130   Close attention needs to be paid to monitoring and controlling workflows throughout the entire processing phase. Each activity depends on the quality and quantity of the output from the previous activities. Once all activities are fully operational, it is critical that each activity meets production targets to ensure that the following activity has sufficient work.

5.131   Delays in one activity can lead to costly lost production in the following activities. If difficulties are being experienced in one activity, managers may need to reallocate resources between activities or change procedures in order to raise production levels. Any proposed changes in procedures to raise production will have to be carefully considered to ensure that the quality of the data is not adversely affected.

3.1   *Movement of forms*

5.132   In some processing systems (such as handheld devices and Internet), there will be no physical forms. In other systems (optical scanning), physical forms will only be required up until data capture. After this, electronic images of the forms will be transmitted throughout

the remaining activities, with the physical forms only required for disaster recovery. In yet other systems, the physical forms will be required for all activities.

5.133   When physical forms are used, controlling the movement of the forms between relevant activities needs to be done efficiently and in a controlled manner. This can be done through a flow control system. These systems can be clerically based or sophisticated automated systems that track material in real time. Advancements in technology have brought the development of cost-effective stock control systems that use barcodes for tracking purposes. These systems are ideally suited for tracking boxes containing census forms. Regardless of the type of system used, a flow control system should contain the following:

(a) Movement rules that specify both legal and illegal movements – for instance, forms cannot be moved to manual data entry before they have passed through the coding operation;

(b) Flexibility to allow forms to be flowed back to previous activities if reprocessing for a particular enumeration area is necessary;

(c) Provision for timely management information about workflow and location of forms (for example, number of enumeration areas in an activity and exact physical location in the processing centre of an enumeration area).

3.2   *Status of data*

5.134   Apart from controlling the movement of forms, it will also be necessary to control the transfer of the electronic data. In many processing systems, there will be a variety of automated stages that manipulate and transform the data files. The number of these automated stages can often exceed the total number of activities shown above in figure XIII. These automated stages can include the following:

(a) Edits that check for inter- and intra-record consistencies;

(b) Derivations of data items (such as labour force status);

(c) Imputations for missing data items based on the values of other data items;

(d) Imputations for number of persons in households where forms are missing;

(e) Quality assurance;

(f) Aggregations and transformation of files for final release of the data from the processing centre.

5.135   The automated system used to control the movement of data is commonly referred to as process control. The process control system is similar to the flow control system mentioned above but reports and controls the different stages of the data files rather than the physical forms. The system should report on the stage of each workload (such as enumeration area) and contain the following:

(a) Rules that specify when the next automated stage can begin – for example, labour force derivations cannot commence until all labour force variables have been coded;

(b) Flexibility to allow the stage of a data file to be reset if reprocessing is required for a particular enumeration area, household or topic;

(c) Provision for timely management information about the stages of files.

4.   Management information system

5.136   An essential tool for managers at a processing centre is a management information system. An effective management information system enables efficient activity monitoring and can improve the effectiveness of decision-making within the processing centre.

5.137   The general requirements of a management information system are as follows:

(a) To allow access to all relevant management information by the different levels of management in the areas of production, workflows, staffing information, quality assurance and budget control;

(b) To ensure that all management information is as timely and detailed as needed, while maintaining integrity and accuracy of collected data;

(c) To forecast and report on the outcome of future activities within the processing centres for crisis resolution to determine the effects of alternative decisions, and to highlight potential problem areas before they arise;

(d) To ensure that information acquired in one census can be utilized for planning in future censuses.

5.138   Activities at the processing centres need to be monitored closely to assist with the smooth running and integration of all activities. This will ensure that timetables and budgets are met, and that data produced are of a high standard. Because large amounts of data can be processed very quickly, it is imperative that the management information system delivers timely and accurate data to management. The vast majority of census processing is conducted using computerized systems. Therefore, the capture and production of management information data can be automatic and should be regarded as an integral component of the processing system.

5.139   Management information data can be made available in a variety of standard reports in a form that allows different managers to select the level of detail in which they are interested. For example, senior management at the processing centres may only be interested in overall production rates, whereas middle managers may be interested in individual section production rates, and supervisors in production rates for individuals. Therefore, information should be collected at the finest level of reporting (individual) and then aggregated to broader levels of detail (such as section) for reporting purposes.

4.1   *What to collect*

(a)   Production rates

5.140   The production rates achieved in each activity will determine whether timetables will be met. Therefore, to monitor production, the following will need to be collected for each activity:

   (a) Units completed;

   (b) Total processing hours worked; from which then derives;

   (c) Production rates (units per hour).

5.141   The base measurement of units can comprise enumeration areas, households or dwellings, persons, or a combination of these units. The measure used will depend largely on the nature of the processing system and the workload allocation system used to distribute work to staff.

(b)   Flow control

5.142   In order to control workflow it is necessary to monitor the flow of material throughout all processes. Therefore, the following will be needed:

   (a) Total number of units and overall percentage not yet started, by each activity;

   (b) Total number of units and overall percentage currently within each activity;

   (c) Total number of units and overall percentage completed for each activity.

(c)   Staffing

5.143   A large component of the census budget is salaries for processing staff. To monitor this activity the following will be needed:

   (a) Staff numbers by activity;

   (b) Salary costs by activity.

(d)   Quality assurance

5.144   Ensuring that the data meet the minimum required standards will be an important focus of managers at the processing centres. The quality of the data produced should be monitored over the complete processing cycle. To accomplish this, the following will be needed:

   (a) Error or discrepancy rates by activity or topic;

   (b) Error or discrepancy rates by individual by topic.

5.145   A detailed description of quality assurance strategies is contained in section F below.

(e)   Automatic edits

5.146   In many processing systems, there will be a series of automated edits (see subsection 3.2 above). Because these edits are automated, it is important that they be monitored to

ensure that they are functioning as specified and that they are not producing unexpected results. A simple method of doing this is to automatically record the number of times each edit is applied. Examining these data may also alert managers to anomalies in the census data. For example, there may be a larger-than-expected count for an edit that checks on inter-record consistency (for example, number of people under 15 years of age reporting an occupation). This may indicate a processing system error (such as incorrect data capture of age values) or may be attributable to respondent error.

4.2 What to report

5.147   Managers need information on production to monitor progress.

5.148   Before the establishment of the processing centres, production plans should be drawn up that show expected production rates for each activity over time. During production, the management information system should automatically measure actual production rates and compare these to the original production plan. This will enable managers to track progress easily and will allow the early detection of bottlenecks in processing or delays in the timetable.

5.149   The reports above can be broken down to finer details (groups, sections or individual persons) to show respective managers how their section compares with other sections and with the overall average for an activity.

4.3 Feedback to individuals

5.150   While the reports described above, with varying degrees of detail, can be utilized by the various levels of management at the processing centre, it is also important to provide timely feedback to individuals on their own performance. The reporting period for these reports can vary (weekly, fortnightly or monthly), but regular performance feedback to staff allows them to compare their own performance with the rest of their section.

E.   Technology issues for processing

1.   Introduction

5.151   The successful introduction of technology into the processing phase will have an important impact on the overall success of the census. The nature of census processing (that is, the capture and manipulation of large amounts of data) is ideally suited to computerized technology.

5.152   In fact, census processing has a long association with computers. The first commercially available computer, the UNIVAC I, was first installed at the United States Bureau of the Census in 1951. Since that time, advancements in technology through the different generations of mainframes and the rapid advancements in PCs and handheld devices have enabled census agencies to become sophisticated in the way in which they process and

manipulate data. This has led to more efficient and cost-effective processing and, ultimately and more importantly, provided a better product for the users of census data.

5.153   The use of sophisticated technology, such as the rapidly emerging technology of handheld devices, offers great potential and associated benefits for census processing. However, agencies also need to be aware of the lead times and technology infrastructure required for the successful implementation of a new technology. A variety of data capture systems, in particular optical scanning and handheld devices, are discussed in the sections below. Details on this technology are provided because they are viable for census operations and are being adopted by many agencies in the 2020 round of censuses.

2.   Processing platforms

5.154   The increase in processing power and storage capacities of the mid- and lower-end systems such as PCs has provided new opportunities for many countries. The associated reduction in costs of these platforms has also contributed to the trend of countries moving away from expensive mainframe solutions.

3.   Data capture methods

5.155   For the purposes of the present handbook, data capture is defined as the system used to capture the information from the census form and create associated digital data files. Data capture systems include the following:

   (a) Manual entry;

   (b) Optical scanning;

   (c) Handheld devices;

   (d) Internet and computer-assisted telephone interview.

5.156   Each system has different advantages, costs and impacts on hardware and software requirements at both data capture and later stages. A complete census data capture system may contain a combination of more than one of the above. In the present section, the primary focus is on optical scanning and handheld device data capture, as this technology is becoming increasingly common for censuses.

3.1   Manual entry

5.157   In manual data entry systems, staff manually enter every response from the census form or image into computers. This method requires staff with IT skills to set up a large computer network and all associated responsibilities for supporting a large number of computer users. The software systems and computing hardware utilized for manual data entry are typically fairly simple. However, this method does require many more staff than do the automated data entry systems, and is likely to take a longer time to complete. The decision to use manual entry versus automated entry is partly based on timetable requirements, the size of a country's population and the relativities between staff and hardware costs. Where staff

costs are low and computing infrastructure moderate, manual entry may be the optimal method.

5.158   Manual data entry systems can also require either post-collection processing to group non-numeric responses into numeric classification classes or codes, or a clerical process prior to keying to assign the codes to be keyed.

5.159   The two primary methods census agencies employ to capture census data are the following.

(a) **Key from paper.** Key from paper requires an operator to key data directly into a data entry application from the physical census form. This method requires the least amount of technical expertise to implement.

(b) **Key from image.** Key from image involves capturing the completed census forms using a scanner that takes an image of each page of each form. The image file that results from the scanning process is then sent to computer screens for operators to select or enter the appropriate corresponding responses for each question. This keying method is known as heads-up processing, in that the operators refer to an image on the screen rather than the physical census forms.

5.160   The advantage of heads-up processing is that savings are possible from the reduced paper handling, as the electronic images can be used in place of the actual forms. Heads-up processing is more efficient and results in greater operator productivity. That said, it is uncommon for a census agency to rely entirely on key from image to capture census data. Rather, key from image is often part of an ICR capture operation (discussed below).

3.2   Optical scanning

5.161   Optical scanning is another method often utilized by census agencies to capture census form data into computer systems. The two most common optical scanning data capture methods are the following.

(a)   Optical mark recognition

5.162   Optical mark recognition (OMR) machines read responses to tick-box type questions on specially designed forms. Only the presence or absence of a mark is detected by the machine and any handwritten responses must be later manually entered or coded by way of computer-assisted methods. The specially configured OMR scanners automatically and immediately interpret and pass responses into a computer system file or database without the use of a keyboard. Figure XIV shows an example of a census form prepared for OMR.

Figure XIV

Questionnaire for the 2010 population and housing census in Zambia

5.163 The advantages of OMR include the following:

   (a) The capture of tick-box responses is much faster than manual entry – OMR machines will typically read, on average, 7,000 A4 pages per hour.

   (b) Equipment is reasonably inexpensive.

   (c) OMR is relatively simple to install and run.

   (d) It is a well-established technology that has been used for a number of years in many countries.

5.164 Disadvantages of OMR include the following:

   (a) Precision required in the printing process;

   (b) Restrictions on the type of paper and ink that can be used;

   (c) Precision required in cutting of sheets;

   (d) Restrictions as to form design;

   (e) On occasions, software recognizes non-existent marks;

   (f) Requirement that response boxes be correctly marked with appropriate pen or pencil.

5.165 OMR forms may be marked by the respondents or the interviewers, or responses may be transcribed from the census forms onto OMR sheets by staff in the data-processing

centres. However, the latter method of transcription in the office is regarded as inefficient and a source of errors.

(b)   Intelligent character recognition

5.166   Intelligent character recognition (ICR) systems interpret number and letter character responses from electronic images of scanned forms. ICR technology interprets responses defined in specific locations on the forms and transforms the written responses into output data. Figure XV presents an example of a census form prepared for ICR.

Figure XV

Questionnaire for the 2009 population and housing census in Kenya

A: Information Regarding All Persons											
Name	Line Number	Relationship	Sex	Age	Line Number of Mother	Usual member of house-hold	Tribe/ Nationality	Religion	Marital Status	Birth Place	Previous Residence
(P-00)		(P-10)	(P-11)	(P-12)	(P-13)	(P-14)	(P-15)	(P-16)	(P-17)	(P-18)	(P-19)
What are the names of each person who spent the night of 24th/25th August, 2009 in this household? (Record two names of each person, young and old, starting with the head of the household.) An illustration of how to write the names is shown below. PATRICIA ODENG	Illustration 0 1, 0 2, 0 3, 0 4, 0 5, 0 6, 0 7, 0 8, 0 9, 1 0	What is <NAME>'s relationship to the head of this household? 1=Head 2=Spouse 3=Son/Daughter 4=Grandchild 5=Brother/Sister 6=Father/Mother 7=Nephew/Niece 8=In-Law 9=Grandparent 10=Other Relative 11=Non-relative 99=DK	What is <NAME>'s sex? 1=Male 2=Female	How old is <NAME>? (Record age in completed years using two digits. If under 1 year, record "00". If 95 years and above code 95)	Please insert line number of <NAME>'s biological mother ENTER "00" IF BIOLOGICAL MOTHER IS NOT IN HOUSE-HOLD	Is <NAME> a usual member of this house-hold? 1=Yes 2=No	What is <NAME>'s tribe or nationality? For Kenyans, write tribe code. For non-Kenyans, write code for nationality. The code list is provided.	What is <NAME>'s religion? 1=Catholic 2=Protestant 3=Other Christian 4=Muslim 5=Hindu 6=Traditionalist 7=Other religion 8=No religion 9=DK	What is <NAME>'s marital status? 1=Never married 2=Married Mono-gamous 3=Married Poly-gamous 4=Widowed 5=Divorced 6=Separated 9=DK	Where was <NAME> born? Write district code, if in Kenya, or country code, if outside Kenya. The code list is provided.	Where was <NAME> living in August 2008? Write district code, if in Kenya, or country code, if outside Kenya. If aged under 1 year, write "000". The code list is provided.
	1										
	2										

5.167   Figure XVI details the process of capturing census data using ICR, while the ensuing text describes each of the steps involved.

Figure XVI

ICR processing system architecture

```
  ┌──────────┐              ┌──────────────┐
─▶│ Scanning │─────────────▶│ Physical form│
  └────┬─────┘        ┌────▶│   storage    │
       │              │     └──────────────┘
       ▼              │
  ┌──────────┐        │     ┌──────────────┐
  │Recognition│◀──────┼─────│ Image storage│
  └────┬─────┘        │     └──────┬───────┘
       │              │            ┊
       ▼              │            ┊
  ┌──────────┐        │            ┊
  │ Automated│        │            ┊
  │  repair  │        │            ┊
  └────┬─────┘        │            ┊
       │              │            ▼
       ▼              │     ┌──────────┐   ┌────────────┐
  ┌──────────┐   ┌────▼─────┐│Automatic │   │ Computer-  │
  │ Operator │──▶│Automatic │─▶│assisted or │
  │  repair  │   │  coding  │   │manual coding│
  └──────────┘   └──────────┘   └────────────┘
```
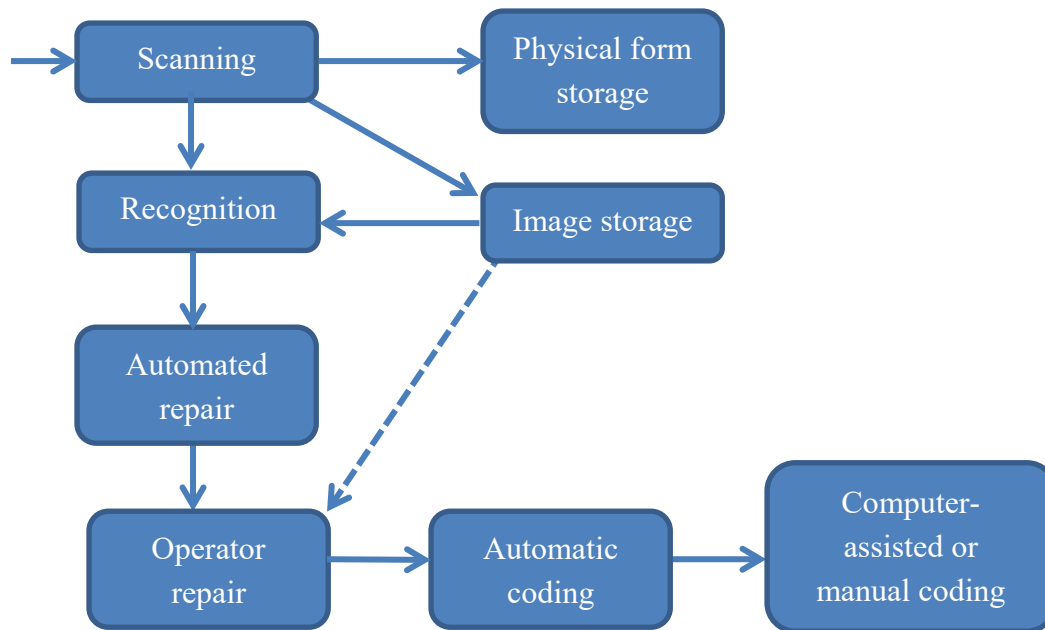
(c)   Scanning

5.168   First, the census forms are processed through scanners, which take an image of each page of the census form, resulting in image files.

5.169   Once images for all forms in a suitably sized workload (which can be smaller than a complete enumeration area) are captured, they are loaded to network storage and data collection from them can begin. The physical forms are placed in store, with minimal further reference expected, while images are transferred to nearline storage and off-site backup.

(d)   Recognition

5.170   The first step in the data capture process is to "recognize" the data from the images. The images are processed by software commonly referred to as a recognition engine. The recognition engine processes the raw data from the form using predetermined confidence levels that indicate how confident the recognition engine is that the character it recognizes is valid. This process can be undertaken in batch mode on PCs or servers.

5.171   Recognition generally occurs using one of two methods. The first method is based on creating histograms of each character and matching the histogram against a pre-identified set (character set) of histograms. The similarities between the input and character set histograms are scored and the highest scoring match is returned. The second method, which has similarities to histograms, is where the input character image is split into a number of components. These components are matched against a similarly created character set, with the character with the highest number of matching components being the one returned.

(e)   Automated repair and validation

5.172   Those fields on the census form that contain characters not recognized by the recognition engine can then be transferred to an automated repair process. This automated

process is used in an attempt to reduce the amount of operator repair required for unrecognizable characters. This process usually involves using dictionary look-up tables and contextual editing.

5.173   For example, the recognition engine may recognize the majority of characters (apart from one) in a response to a question on a person's birthplace. The characters in the text string may be recognized as "La Pa*" with -*- indicating a character the software could not recognize. This text string can then be passed through a dictionary that is specifically associated with that particular topic. In this example, it would be a list of cities in Bolivia. If the text string only matches one entry in the dictionary where all characters in the text string match, regardless of the missing character, then the missing character in the text string could be assigned a value. In this example, the missing character would be assigned a value of "z" so that the response would be "La Paz".

5.174   A generic dictionary should not be used in this process. Instead, various dictionaries that are tailored to particular census topics or variables should be used. For example, responses associated with occupation should be matched with a dictionary that only contains typical occupations that occur in a particular country. This method is usually better for simpler topics, which have a smaller number of possible responses, such as country of birth. This process can also be used for numeric fields, such as postcode, where the possible values are known.

(f)   Operator repair

5.175   For those characters that cannot be recognized by the recognition engine, or assigned by the automatic repair process, operator repair (key from image) will be required. In this process, operators will examine the individual images of these characters and either confirm or correct what was identified by the recognition engine. Operator repair should only be carried out for selected fields that have a high probability of being coded automatically, with the images for other fields being directly transferred to the coding process. It is also important to fully repair numeric data.

5.176   Some systems provide other repair methods, which can speed this process, or, alternatively, provide options that allow all responses to key fields to be verified.

5.177   Once the dictionary look-up system has either recognized all the characters or operator repair has been carried out, the data can be passed on to the automatic and manual coding processes.

(g)   Advantages of intelligent character recognition

5.178   An ICR solution can be expected to provide the following advantages.

   (a) Savings are made in salaries owing to the reduced number of staff needed to code responses, as a proportion of the recognized handwritten responses can be automatically coded without any human input.

(b) Additional savings are possible through the efficiencies gained by using electronic images rather than physical forms. These include savings from not having to physically move forms, and the increase in production that is possible from coding staff referring to images rather than physical forms.

(c) Automatic coding will provide improvements in data quality, as consistent treatment of identical responses is guaranteed.

(d) Processing time can be reduced owing to the automated nature of the process. This can lead to a significant reduction in time for census results to be released to users and thus contribute to an important component of data quality (namely, timeliness).

(e) Form design does not need to be as stringent as that required for OMR.

(f) Digital filing of forms is enabled, resulting in efficiency of storage and retrieval of forms for future use.

(h)   Disadvantages of intelligent character recognition

5.179   The disadvantages associated with an ICR solution are as follows:

(a) Costs of equipment are higher owing to the sophisticated hardware and software required.

(b) Character substitution can affect data quality. This occurs when the recognition engine returns a value for a character that is not the same as the response on the form.

(c) The tuning of the recognition engine and the process to accurately recognize characters is critical, with trade-offs between quality and cost.

(d) Handwritten responses must be written in a constrained response area and be recognizable by the software.

3.3   Handheld devices

5.180   A handheld device, such as a smartphone or tablet, is increasingly becoming a substitute for traditional paper-based enumeration. With this methodology, a census agency's data processors program the census form in a data entry application, replacing the traditional paper form with a series of sequential questions appearing on the handheld device. The enumerator reads the questions as they appear on the screen and enters the response by either selecting a predefined response or entering a value.

5.181   A census agency's data processors program skip patterns in the data entry application loaded onto the handheld device, guiding the enumerator through the questionnaire. For instance, if data are being collected for a female 5 years of age, the data entry application can be programmed to automatically skip questions that are not applicable, such as industry and occupation. While this provides the census agency with the ability to better guide enumerators through the questionnaire, it can also lead to problems if the data entry program is not thoroughly tested. For example, if the data entry program erroneously skips questions

concerning fertility for females aged 15–29, then the enumerator will not be prompted to ask the questions and the census will be unable to produce key fertility indicators.

5.182 Thorough testing of the data entry application is key for the success of the operation. Testing must include both functional testing (testing for correctness) and usability testing (testing that a typical enumerator finds the application easy to use). In addition, field testing, in particular that of the data transfer parts of the system, is required.

5.183 Data can either be stored locally on the device or be transmitted to a central location. The feasibility of transmitting data from the handheld device to a central location requires appropriate communication infrastructure and measures to ensure security for data during transmission. For areas with limited connectivity, data from the handheld devices can be transmitted in other ways, including (a) memory stick; (b) direct attachment to host computer; or (c) device-to-device transfer (for example using Bluetooth). A mix of methods for transmitting census data can be employed. For instance, a country may choose to have the census data transmitted wirelessly from urban areas, where the required communication infrastructure exists, and employ another mode of transmission for data collected from rural, less well-connected areas.

5.184 Multiple security features exist for handheld devices to protect data in case the devices are damaged, lost or stolen. Some potential security features include:

(a) Immediately and automatically transferring data to a central location, thereby foregoing the need to store data locally on the device;

(b) Encrypting locally stored data;

(c) Password protecting the device.

(a) Advantages of handheld devices

5.185 A key advantage of utilizing handheld devices for census enumeration is the ability to capture the data at the point of collection. Rather than having the enumerator collect and enter responses on a paper form, transporting the forms to the data-processing centre, coding the required variables, and capturing the responses into electronic format (as is the case for manual entry and optical recognition, discussed above), the use of handheld devices enables the data to be collected and captured simultaneously. The result is often a substantially shorter timeline for processing census information and, subsequently, for disseminating results.

5.186 Handheld devices enable the enumerator to immediately validate information by probing the respondent when there are logical errors in the responses. This is achieved by incorporating an editing program in the application, thus enabling instantaneous validation of the consistency of the provided information.

5.187 Handheld devices have advantageous functionalities, including:

(a) Ability to make telephone calls or send instant messages when questions arise in the field;

(b) Enumeration area maps and address information, detailing assignments;

(c) Use of geotracking to ensure the complete coverage of the enumeration area;

(d) Automatic case management for non-response follow-up;

(e) Satellite imagery for housing unit identification.

(b)   Disadvantages of handheld devices

5.188   The disadvantages associated with handheld devices include:[71]

(a) The complexity of developing applications for handheld data collection, requiring a significantly higher skill level than traditional key-from-paper systems, leading to difficulty finding qualified application developers;

(b) Possible challenges identifying enumerators who are computer literate and can easily navigate a handheld device;

(c) Training enumerators on how to use, navigate and troubleshoot the handheld device and data entry application is more intensive than for other modes of capturing census data;

(d) The need to recharge the battery of the handheld device;

(e) Potential equipment failure;

(f) Difficulty of transferring data in regions without network connectivity;

(g) High initial cost to purchase large number of devices.

3.4   Internet and computer-assisted telephone interviews

5.189   The use of Internet and CATI for census collection is growing. However, this method is usually administered in conjunction with other methods.

5.190   Capturing census data through the Internet or CATI is similar to handheld data collection in that the online form is usually not the exact downloadable version of the paper-based form. Rather, it is an application that guides the respondent through the questionnaire. It is common for the questions to appear either a page at a time or sequentially.

5.191   Internet data capture is unique in that it is self-administered, meaning that the respondent completes the form without the assistance of an enumerator. This method provides respondents with a web address to access the online form. Use of this method requires the census agency to ensure the confidentiality and security of the responses, preventing access to hackers. Moreover, census agencies will require a level of authentication in order to validate and grant access to the correct members of the public.

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[71] Depending on the practices in a given country, these obstacles can also include, as is the case in India, (a) difficulties arising from using templates on multiple languages on the same device; (b) difficulties in recording non-coded descriptive returns; and (c) difficulties in using the signature of the respondent as a mark of authentication.

5.192   Testing the flow and skip patterns of the online form is essential in ensuring an intuitive and efficient user experience. The census agency's data-processing team should conduct multiple tests to study how the general public will respond to the online form and make the necessary adjustments prior to the actual census.

5.193   Housing units without Internet access or those experiencing difficulty completing the online form will be provided with a phone number to call. In these cases, the form may be completed using CATI. CATI is a method whereby a housing unit is contacted over the telephone by an interviewer who follows an on-screen script to administer the Internet form on behalf of the housing unit.

4.   Coding

5.194   Coding systems assign classification codes to the various written responses on the census form. These coding systems can be: (a) clerical; (b) computer assisted; (c) automatic; or (d) a combination of all three.

5.195   The coding systems can use different coding methodologies, namely, simple, structured or bounded methodologies.

5.196   Simple matching can be used for those topics where coding is reasonably straightforward and limited to reference to one question on the census form. An example of this is the birthplace topic, where a limited number of words (one or two) in the response can be matched against a simple alphabetical list.

5.197   Structured coding is used for more complex topics such as occupation. To code these topics, reference may need to be made to more than one question on the census form. For example, some occupation responses can be coded by reference to the occupation title question. However, a large percentage of responses can only be coded by referring to other questions on the census form, such as tasks performed or industry. These coding rules can be built into the structured coding system to guide the operators.

5.198   Bounded matching (sometimes referred to as hierarchical matching) is used for those topics where it is necessary to obtain different levels of detail before a code can be assigned. This method is commonly used for coding of addresses. For example, an operator may start the search at a broad geographical level (for example, province or state) and, after matching at this level, continue on to further levels (for example, region, city, street and even street number), as necessary, to obtain a classification code.

5.199   Regardless of which system is used, they all rely on coding indexes. These indexes are lists of typical responses that are likely to be given on a census form and have an associated classification code assigned to them. An important point to note about these indexes is that they should be based on what respondents report and not simply contain the categories in the classification structure. The indexes should be regarded as a map that enables responses to be classified into the various classification structures. Respondents do

not provide answers in classification terms but in everyday language, and the indexes should reflect this.

5.200   The quality of the indexes that are constructed has a direct influence on both the quality of data and the efficiency of processing. Managers should make sure that the effort and time required to build these indexes should not be underestimated, and sufficient lead time should be built into census plans for this important task. These indexes are not static and will need to be updated during processing to cater for new responses.

4.1   Clerical coding

5.201   Clerical coding involves the processor matching the response on the census form with responses contained in one or more indexes that are commonly referred to as codebooks. The processors then transfer the associated code from the codebook onto the form for later data capture. This clerical process is tedious and can be subject to higher errors than other types of coding. Using this method, processors also tend to rely on their memories for coding, which can introduce further errors into the process.

4.2   Computer-assisted coding

5.202   This method involves processors using computerized systems to assist in the coding process. Similar indexes to those used in clerical coding are used, but they are computer based. The processor usually enters only the first few characters of each word in the response, and the system then returns a matching list from the appropriate index. The coder then selects the matching index entry and the code can be automatically written to the data file. Computer-assisted coding is used during handheld device and Internet-based data capture operations.

5.203   An advantage of computer-assisted coding is that more coding rules can be incorporated into the system to guide the processors through several processing steps, which results in higher-quality data. Computer-assisted coding is particularly suited to the structured coding approach mentioned above.

5.204   Structured coding also has the advantage of reducing the number of potential matches presented to the operator on the screen. This is done through the use of basic words (usually nouns) and qualifying words (usually adjectives). For example, a processor may enter the text string "far pou" for the response poultry farmer. The system would return a list of all basic words beginning with "far" and after the operator confirms the basic word as farmer, a list of all qualifying words beginning with "pou" would then be presented. After selecting the correct qualifying word, "poultry", the appropriate code would be written to the file. Reducing the possible number of matches on the screen reduces operator burden and results in higher-quality data.

5.205   Countries that have developed computer-assisted systems have found them to be more efficient than clerical systems and result in higher-quality data. However, the system and associated indexes are relatively complex and require a long lead time to develop. This

cannot be emphasized enough, as this new technology requires far more upfront planning and time to develop than capturing from paper. Also, the costs of developing these systems should not be underestimated, and the assistance and advice of other countries that have developed them should be sought.

4.3   Automatic coding

5.206   Automatic coding uses computerized algorithms to match captured textual responses (for example, from ICR) against indexes without any human intervention. The matching algorithms used in automatic coding are complex and usually involve a scoring mechanism whereby a particular score is required before a response is regarded as a match. There are a variety of algorithms that can be used for automatic coding, and a complete handbook could be devoted to this subject. However, it should be noted that caution is needed when implementing any automatic coding matching algorithm. Faults in either the algorithm or associated indexes can result in incorrect codes being assigned. Because of the complex nature of these systems, it would be a good practice for agencies that are considering using automatic coding to contact other countries that have developed these systems.

5.207   Depending on the algorithm used, tests have shown that automatic coding will achieve high match rates (approximately 80 per cent) for simpler textual responses such as birthplace. However, responses for the more difficult topics such as occupation and industry will achieve much lower match rates (approximately 50 per cent).

5.208   Regardless of the system used, it will not be possible to code all responses automatically. Therefore, those responses that cannot be coded automatically will need to be further processed at a later stage through either computer-assisted or clerical coding.

5.   Data editing

5.209   The end objective of the census data-processing stage is to produce a data file free from errors and inconsistencies. However, errors and inconsistencies will undoubtedly arise during the data collection, coding or capture phases. Data editing is the process of detecting as many of these errors in the data file as possible and making changes to the data file so that the responses are valid and consistent.

5.210   The focus of the present section is on the process of editing census data following manual entry or optical scanning, as these are currently the predominant modes of capturing census data. Editing procedures for handheld device or telephone and Internet data capture vary significantly, as the data entry application will contain programmed checks, preventing some of the errors in the capture stage. Given that these modes simultaneously collect and capture data, they have the great benefit of being able to directly probe the respondent to correct any logical errors or inconsistencies.

5.211   As noted in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part three, chap. VIII, sect. E, errors can be either critical or non-critical. Critical errors have the potential of blocking further processing and must be

corrected. Non-critical errors produce invalid or inconsistent results without interrupting the logical flow of subsequent processing phases. As many of the non-critical errors as possible should be corrected. These errors are often classified as coverage or content errors.

    (a) Coverage errors are errors that arise from either failing to enumerate a person or housing unit, or counting a person or housing unit multiple times.

    (b) –Content errors are errors that arise from incorrectly reporting or recording characteristics from persons, households or housing units.

5.212 Both errors are better resolved in the field, but can be edited during the census data-editing phase. More information on coverage and content errors is provided in chapter VII, section C.2.

5.213 As stated in the *Handbook on Population and Housing Census Editing, Revision 1*, "Editing comprises the systematic inspection of invalid and inconsistent responses, and subsequent manual or automatic correction (using 'unknowns' or dynamic imputation), according to predetermined rules."[72] While some editing operations involve manual corrections, which are corrections made manually in the office, the majority of editing involves electronic corrections using computers. This is primarily for two reasons. First, the size of the census operation makes manual editing economically unfeasible. Second, utilizing computers for census data editing removes human error and ensures consistent application of editing specifications.

5.214 It is important that the census agency form a team responsible for developing the editing rules and programs. This team should comprise census managers, subject matter specialists and data processors. The subject matter specialists will develop the edit and imputation rules or specifications, which detail the consistency rules and corrective measures. These specifications will then be provided to the data-processing staff, who will program the rules in an editing software package. Having continuous communication between the team members is essential in ensuring that the editing process is fast, efficient, effective, and comprehensive, and achieves the right balance without overediting. Also, management should make sure that there is close collaboration between the subject matter specialists and programmers while developing these programs.

5.215 Imputation is the process of addressing the missing, invalid or inconsistent responses identified during editing. This process involves altering one or more responses or missing values for a person or household or for other persons or households to ensure that the data are plausible and internally coherent. Whenever imputation is used, a flag should be set so that analysts are able to distinguish between reported information and that imputed by the editing system. The proportion of imputed records should be made available to users as a data quality measure. Common imputation techniques include: (a) static look-up tables (cold-deck imputation); (b) dynamic look-up tables (hot-deck imputation); (c) assigning a value (for

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[72] *Handbook on Population and Housing Census Editing, Revision 1* (United Nations publication, Sales No. E.09.XVII.11), United Nations Statistics Division, New York, 2010.

example, 0 or 99) for unknown responses; and (d) use of administrative data or other sources for missing items.

5.216   In cold-deck imputation, the editing program assigns a particular value for a missing item from a predetermined set, or the response is imputed on a proportional basis from a distribution of valid responses. More specifically, cold-deck imputation uses a prestored look-up table, which is often derived from reliable data from previous censuses, surveys or other sources, to impute missing values. Often, these look-up tables may contain multiple variables.

5.217   Hot-deck imputation is a more complex method. In this method, a missing value for a particular field is imputed from data from a different record. It involves searching back through the census records until a preceding similar record is found that does not have a comparable inconsistency. The values from the field in that record are then copied to the record with the missing value. For example, income may be missing for a particular record, although it contains occupation and industry responses. The system could search for a preceding record that contains the exact same combination of occupation and industry, with a stated income. The income from this preceding record is then copied to the record missing this value.

5.218   Since its inception, the hot-deck approach has been adopted by census agencies as it uses existing data and, as such, is regarded as statistically sound. The process of using hot-deck imputation must always carefully record the total number and variables that are subject to it; at the same time, it is also important to preserve original data, as the analysis of imputation is critical for assessing the initial quality of raw data.

5.219   More sophisticated software programs for editing and imputing inconsistent and missing data have been developed and used in some countries. These build on the principles of hot-deck imputation, but impute a range of related missing data in one instance (for example, imputing nationality, religion and ethnicity at the same time), from the same donor record, to ensure internal consistency and plausibility. These systems have been demonstrated to deliver more accurate corrections to the data, but are considerably more complex to develop and administer, requiring significant subject matter expertise.

5.220   While the process of census editing essentially cleans the data file of errors and inconsistencies, census agencies should be careful not to overedit data. Overediting may increase the time required to disseminate results, increase costs, distort true values and not necessarily add value to the final product. A general rule of editing is to take a minimalist approach and not overedit errors that are beyond what are considered obvious respondent or interviewer mistakes and responses that are clearly out of range.

6.   Data management

5.221   Data management is particularly critical in a distributed processing environment where there may be hundreds, if not thousands, of PCs connected on a local area network (LAN) or a wide area network (WAN).

5.222   Some basic considerations that are applicable to a variety of systems, regardless of the technology used, are discussed below.

6.1   Data storage

5.223   During processing, data will pass through a number of sequential activities from data capture through release of files to the dissemination phase. Each activity will refine and change the data in some way. Therefore, it is advisable to maintain copies of all versions of data for auditing and tracking purposes. This will enable easy pinpointing of where problems were introduced and where corrective actions can be taken.

5.224   The technology used for data storage depends on the architecture chosen for the data capture and processing systems. Simple text files may be sufficient, if appropriate to the architecture. Whatever data storage system is used, a key issue is the management of large volumes of data and multiple versions of files as the data pass through each activity. The management of the data also needs to address issues such as retrieval for the various activities within specified response times. A decision on the data storage methodology will depend on the volume of data involved and the complexity of the processing system.

6.2   Data backup

5.225   In order to recover from inadvertent loss of data, it is important that a backup strategy be developed. This strategy may include frequent on-site backups of data and control files, from all stages of processing, and regular off-site backups to protect against major disasters.

5.226   It is also important to have a recovery strategy in place to be able to reinstate all files in a consistent state after the failure of a server, corruption of data or other problems.

6.3   Data security

5.227   The individual record data that are produced during processing should be subject to the same strict security rules that apply to the physical forms. This means that only authorized staff should have access to the unit record files for the purposes of processing. Network and handheld device security will be required to monitor access and prevent access by unauthorized staff. It will also need to provide mechanisms that prevent unauthorized tampering with the data in the files and provide audit trails of all changes.

5.228   Protection against the threat of computer viruses is another important aspect of protecting the data. The introduction, either deliberately or inadvertently, of a virus could have disastrous effects on processing. There is a variety of commercially available software that can be used to reduce this threat.

7.   Methods of tabulation

5.229   While demographers and subject matter specialists are responsible for developing the tabulation plan as they have the necessary expertise to interpret the census results, the data processors are responsible for the following:

(a) Reviewing the tabulation plan to identify whether the desired tables can be programmed;

(b) Programming and testing the tabulation application according to the specifications detailed in the tabulation plan;

(c) Working with subject matter staff to make any final adjustments to the tabulation program;

(d) Populating tables for subject matter review within the shortest possible time frame.

5.230   There are a number of software packages specifically designed to produce census tabulations, such as CSPro. These software packages make the task of programming tables fairly simple and are often free of cost.

5.231   During the selection of software packages for tabulation work, a census agency should consider the following:

(a) Experience and expertise of census agency staff with the software;

(b) Ability of the software to produce the required tables;

(c) Speed with which the large census data file can be tabulated.

F.   Quality assurance for data processing

1.   Introduction

5.232   In chapter II, the quality of census data is defined as multidimensional, involving elements of data accuracy, budget, timeliness and relevance. During the processing of census data, assuming that the criterion of relevance has already been met, the emphasis should be on data accuracy, budget and timeliness.

5.233   While the aim should be to improve all three elements, it may be necessary to improve one element at the expense of another. For example, it may be necessary to add procedures to improve data accuracy at the expense of budget allocation or timeliness. Managers at a processing centre must be responsible for balancing these three quality criteria and must do so with regard to the strategic directions set for their particular census programme.

2.   Total quality management philosophy

5.234   The environment at a census-processing centre is particularly suited to the adoption of a total quality management philosophy. This philosophy is founded on the belief that errors in the output of a process are primarily the result of deficiencies in the process itself, rather than the actions of individuals working in that process. This means that managers must take responsibility for data quality, as they are ultimately responsible for the process in which their staff work.

5.235   However, while managers must ultimately take responsibility for the process, the staff are their most valuable resource when implementing a total quality management philosophy. If this resource is used wisely and staff are involved in the process and empowered to define and achieve useful results, there is every opportunity for success. Implicit in this philosophy is the belief that most people want to work and that the rate and quality of their work are determined by the process. Staff who work in the process are in the best position to advise on improvements to that process.

5.236   While most deficiencies in data quality will be the result of deficiencies in the process, it must also be recognized that census data for particular geographical areas are unique. If a user needs data for one particular geographical area, and the data are of poor quality, they cannot be substituted with data for another geographical area of higher quality. Therefore, it is important to ensure that the quality of the data for each enumeration area is at least of a minimum acceptable standard (for example, Minimum response rate across enumeration areas). This standard needs to be set prior to the census itself, on the basis of pilot census experience.

5.237   Line managers have responsibility for quality by ensuring that staff understand the management philosophy. It is important that the rationale behind the total quality management approach be clearly explained when staff are first introduced to the system. Managers should also ensure that their own behaviour is consistent with the total quality management philosophy, as staff soon notice inconsistencies between what managers say and what they practice.

5.238   Managers need to ensure that staff comments and observations are fed into the quality improvement process. The belief that it is the process rather than the individual that determines the quality of output needs to be reinforced throughout the entire approach to management. Managers should ensure that both formal and informal means are used to encourage staff to contribute, and that staff are comfortable in giving their opinions.

5.239   Providing feedback to staff is an important component of the total quality management philosophy. This feedback should not only concentrate on negative aspects, although this will be necessary in some cases; it is important that staff also receive positive feedback and encouragement.

5.240   To be successful, it is necessary to create a culture in which everyone has the opportunity to contribute to quality improvement at the processing centre. The staff who are employed there perform basically repetitive clerical and screen-based tasks, and it is up to managers to motivate them, and to encourage them to assume some ownership of their work.

5.241   However, while the majority of data quality problems will be the result of deficiencies in the process, there are circumstances where the actions of individuals clearly have an impact on quality. These individuals need to be dealt with by management and, where all else fails (for example, counselling and retraining), their employment should be terminated. By communicating why such decisions have been taken, managers can use these rare events to reinforce to all staff their commitment to quality.

3. Quality management framework

5.242   Processing of census data is a complex exercise that usually involves many different processes (see section D above). While each of these processes can be regarded as a separate entity, each one relies on the quality of the output from the preceding process. To assist in obtaining the highest possible data quality, a framework incorporating the following components can be established at a processing centre:

(a) Quality management system;

(b) Quality assurance points for each process;

(c) Continuous quality improvement processes;

(d) Validation of data.

5.243   Each of these components is discussed in detail below.

4. Quality management system

5.244   Quality management systems that can be incorporated into census processing are in some respects similar to conventional quality control inspection systems, as discussed in chapter II, section N. However, there are some important and significant differences, which are outlined below.

4.1   Units of work selected

5.245   As it would be far too costly to inspect all units of work, a sampling scheme is usually implemented. This sampling scheme can involve selecting a sample of a processor's work that is reprocessed by another processor and the results compared. In some countries, approximately 10 per cent of processors' work is selected for quality management processing.

5.246   Box 29 gives an example of quality management from the Indian census of 2011.

Box 29. Sampling for quality management: 2011 census in India

The quality of the following activities was ensured during the 2011 census in India, on a random sampling basis:

- Printing of materials;

- Procurement of enumerator's kits;

- Completion of questionnaires during the fieldwork by enumerators;

- Image recognition and data processing;

- Scrutiny of final results.

5.247   Sampling schemes to measure the quality of work can be implemented for all stages of census processing, and the actual implementation of such schemes depends largely on the

actual process. However, some general principles can be applied to a wide variety of processes. Some basic rules are as follows.

(a) Sampling rates should be relatively high at the beginning of a process, gradually tapering off to a continuing monitoring rate as processors become more proficient.

(b) More proficient operators should be subject to a lower sampling rate.

(c) All processors should have some of their work sampled over the complete life cycle of the process.

(d) Sampling rates may be increased towards the end of a process so that the quality of work does not suffer as staff lose interest in the process as it comes to an end.

(e) Complex processes (such as coding occupation or industry) should be sampled at a higher rate than simpler processes (such as coding birthplace or religion).

(f) Initial sampling units should be based on operational efficiency. For example, if the basic workload is an enumeration area, the sample should first be based on a percentage of enumeration areas. The sample can then be further refined to a percentage of households within those enumeration areas, persons within those households, and lastly, topics for those persons.

5.248 In the State of Palestine, with a population of about 3 million, verification was implemented at the following rates:

(a) Office editing, 100 per cent;

(b) Office coding, 100 per cent;

(c) Data entry, 100 per cent at the early stages and for new data entry staff, then a random sample of only 5 per cent.

4.2 Method of operation

5.249 The method of operation will largely depend on the process. The following example is based on a quality management scheme for the coding process, where responses from the census forms are coded to a classification.

5.250 A sample of each processor's work is selected by the sampling scheme. This sample can then be reprocessed by another processor (quality management processor) from a different section. The data files produced by the two iterations are then compared. Any mismatches between the two files can be inspected by a supervisor performing the role of adjudicator. The supervisor can then determine what the correct code should have been. A discrepancy is defined as either the original processor's or the quality management processor's code not agreeing with the supervisor's code.

5.251 Involving processors and supervisors in the quality management system, rather than expert coders, will give these staff ownership of the quality of their work. Another advantage in using normal processing staff is that experts tend to use their expert knowledge rather than

following procedures. The objective is to promote consistent adherence to procedures and also to identify systemic errors caused by deficiencies in the process itself.

5.252   Once supervisors have inspected the mismatches, they can provide feedback reports to processors. These reports show the discrepancies between the code the processor assigned and the code the adjudicator believes is correct. The major objective of these reports should be to alert processors to instances where they are not following procedures correctly.

5.253   Supervisors should be trained to provide feedback to the individual processor, in a clear and concise way, such as "You coded the response to X when procedure N says to code the response to Y using these steps". The feedback reports can be standardized to concentrate on providing feedback on adherence to procedures.

5.   Quality assurance points

5.254   As mentioned above, census data for particular geographical areas are a unique product. It is for this reason that there are a series of quality assurance points that every enumeration area should go through during processing. These points ensure that each enumeration area is of an acceptable minimum standard.

5.255   The traditional application of quality assurance points refers to a number of automated checks and measures, systems, and utilities built into the processing system. The purpose of these points is to set measures that can be quantified and used to determine a pass or fail status for the output from a process. This is based on each part of the process having identified points where the progress of the data or output can be flagged as either "pass" or "fail" and used as a measure of the success of that process.

5.256   For example, the overall data produced by the processing system must pass validation (see section 7 below) and be of an acceptable standard for the dissemination phase. Before data reach the validation stage, each process must produce data that are of an acceptable standard for subsequent processes. When the output of a process has passed the checks of the quality assurance point, the next process can proceed. However, if the output fails the checks of the quality assurance point, the next process cannot commence until corrections are made to the output.

5.257   Examples of quality assurance points that may be implemented in a census-processing system (see section D above) include the following.

   (a) **Registration process**. Data for each enumeration area are received at the processing centre.

   (b) **Complete coverage.** Data have been captured for every household in an enumeration area and every person in those households.

   (c) **Coding.** Coding results for each topic in each enumeration area are of a minimum acceptable standard.

(d) **Edits.** Checks and necessary data transformations have been made to ensure consistency of data items, for example, that fertility data only relate to females.

5.258   A common quality assurance point that can be used is to examine coding results in the form of discrepancy rates, as mentioned in subsection 4.2 above. A report can be generated of enumeration areas where the discrepancy rate for any topic is above that defined as acceptable. This report will identify particular enumeration areas that may require reprocessing owing to unacceptable quality. It will also identify those processors who require some type of retraining, either through on-the-job training by their supervisor or formal training.

5.259   Defining what level of discrepancy rates are acceptable before an enumeration area passes this quality assurance point can be based on results that have been achieved in: (a) previous censuses; (b) processing tests conducted for the current census; (c) coding of the same topics in other surveys; or (d) international comparisons.

5.260   Quality assurance points focus on each process achieving the best possible output rather than relying on later processes to correct data. To achieve improvements in all relevant areas of quality (budget, timeliness and data accuracy), it is essential that proactive cyclic measures of quality be used and that problems be addressed at their source. Quality assurance points set a measurable standard and can be fine-tuned to reflect the success of the process. For example, if accuracy is high, tolerances can be refined to reflect a finer detail of checking and improve accuracy further. However, changes in tolerance levels must take into account cost and timeliness issues, as well as quality, and be realistic in terms of what is important to the final outcome.

5.261   Continuous checking of the output from each process is particularly effective in the development and testing of programs leading up to the census. In these tests, there is a greater opportunity for processes and procedures to be thoroughly tested and the output assessed by all stakeholders. Any required changes can be tested again and reassessed thoroughly. There may not be as many opportunities for this during census processing owing to operational pressures.

5.262   Tolerances for quality assurance points used in production can be determined on the basis of the results from the testing programme. Where there are known remaining issues or problems after the testing programme, these can be specifically targeted for measurement in the operational phase.

5.263   Some quality assurance points can be designed not to be mandatory but instead to advise about possible problems. These are measures where the purpose is to flag a possible problem that requires investigation but allows the output to proceed to the next process. An example of this is the tolerance levels set for the number of "not stated" fields. It is to be expected that some topics will be missed by respondents or interviewers, thereby leading to "not stated" values for some fields. An advisory quality assurance point could produce reports where the number of "not stated" fields for an enumeration area is above the average

expected. This could then be investigated to ensure that this is as reported on the forms and was not caused by processors not following procedures or some other system error.

6. Continuous quality improvement

5.264   Continuous quality improvement is a core component of total quality management. The fundamental difference between continuous quality improvement and classic quality control is that, instead of aiming to achieve a specified average quality limit, continuous quality improvement aims to continue to improve the quality of the output of a project throughout the life of that project. Continuous quality improvement will determine the quality of the data produced over and above the minimum standard ensured by the quality assurance points.

5.265   A continuous quality improvement approach can be implemented during census processing in the following ways:

   (a) By using teams of processing staff to identify and resolve quality problems;

   (b) By using quantitative measures of quality, on the basis of discrepancies in the output of the process;

   (c) By giving priority to identifying and addressing the root causes of these discrepancies.

5.266   To ensure that continuous quality improvement is implemented correctly, the following four-step cycle is presented below:

   (a) Step 1: Measure quality;

   (b) Step 2: Identify the most important quality problems;

   (c) Step 3: Identify the root causes of these important quality problems;

   (d) Step 4: Implement corrective action and return to step 1.

6.1   Step 1: Measure quality

5.267   Discrepancy rate data produced by the quality management system should detail the discrepancy rate for both the original processor and the quality management processor for those enumeration areas and topics selected by the system (see examples of reports in section D above). It is important to note that these are not necessarily error rates but are measures of inconsistency in processing.

5.268   Discrepancy rate data provide information on which areas of processing are not meeting the quality targets and therefore allow the first step of measuring quality to be performed.

6.2   Step 2: Identify the most important quality problems

5.269   This step requires that the most important quality problems are identified and that discrepancy rate data are analysed to determine which topics, and particular areas within

those topics, need to be targeted. Compiling profiles of discrepancy data will identify what the most important data quality problems are for these topics.

5.270   The first step is to determine what are the most frequent discrepancies. Therefore, reports should identify the most prevalent discrepancies and remove those discrepancies that are below specified frequency minima.

5.271   The next step is to consider what level of discrepancy should be of the most concern. For example, if coding a particular topic assigns a six-digit code, it could be argued that discrepancies at the major group, or one-digit level, are more serious than discrepancies at the six-digit level. For example, whether a person's occupation is coded as "manager" or "clerk" is a significant discrepancy.

6.3   Step 3: Identify the root causes of these important quality problems

5.272   To perform step 3 of the cycle, information from a variety of sources is needed.

(a)   Case reporting forms

5.273   Staff working in a process are in the best position to advise about how that process can be improved. Processors and supervisors can be provided with case reporting forms that allow them to describe problems they are having with a procedure, processing system or coding index. These forms are also a vehicle for any suggestions they may have about how the process can be improved.

(b)   Adjudication feedback reports

5.274   As mentioned above, supervisors have the opportunity to provide feedback to individuals on the discrepancies between the code they assign and the code the supervisor believes is correct. The major objective of adjudication feedback reports is to alert processors to instances where they are not following procedures correctly.

5.275   Another benefit from supervisors performing this adjudication role is that it provides them with an opportunity to contemplate why these discrepancies are occurring, in particular if a number of processors are making similar errors. Therefore, they will be able to advise on deficiencies in training, procedures, processing systems and coding indexes. This enables them to make a valuable contribution to identifying the root causes of the important data quality problems identified through step 2 of the continuous quality improvement cycle.

(c)   Quality improvement teams

5.276   The use of teams of processors to identify and propose solutions to quality problems is central to the total quality management approach. Separate teams can be established for the different processes at a processing centre.

5.277   The focus of these teams should be to provide a formal mechanism through which staff can contribute to improving the process in which they work. Each team should comprise mainly processors and some supervisors, with a mid-level manager performing the role of facilitator. These teams should meet on a regular basis at the beginning and less frequently

once the major problems with the process are addressed. It is important that participation by staff in these teams be encouraged by management and that members be rotated so that as many staff as possible have the opportunity to contribute in these forums.

5.278   The function of these teams is to assist in identifying the root causes of important quality problems and to recommend corrective action to address these problems. Case reporting forms, as mentioned above, can be passed on to these quality improvement teams. The case reporting forms should be returned to the originator, containing feedback on the suggestions. Members of the teams can also meet with staff in their area to identify problems not raised through formal channels.

5.279   Discussions in the quality improvement teams should be wide ranging and members must feel free to raise any issues they think are relevant. It is important that individuals be provided with information about the process, if they request it. Otherwise, they will not be in a position to make sound suggestions for improving the process and will be less willing to contribute to continuous quality improvement.

5.280   A record of the discussions at these quality improvement team meetings should be distributed to all processors and suggestions sent to management of the processing centre. These suggestions can then be considered by management (see step 4 below).

6.4   Step 4: Implement corrective action and return to step 1

5.281   The first part of step 4 of the cycle is to implement corrective action to address the root causes of the quality problems identified in step 3.

5.282   Before any corrective action is implemented, the ramifications of these changes must be carefully considered so that the implications are fully understood and predictable. Therefore, proposed changes should be considered at a high management level at the processing centre. This could be done through the establishment of a quality management steering committee.

5.283   Managers can consider information from a variety of sources, including the issues and suggestions generated by the quality improvement teams. It is important that managers provide timely feedback to the quality improvement teams on the issues raised in their reports, and any proposed corrective action. In some cases, while the suggestions may be worthy of consideration, they cannot be implemented for a variety of reasons (for example, technical reasons, cost or adverse impact on other processes). The reasons for not implementing the suggestions should be clearly stated in the feedback to the quality improvement teams.

5.284   It is important that the contribution of processors and supervisors be acknowledged, otherwise this contribution may not continue. Changes to be implemented should be seen as coming from the suggestions of quality improvement teams, rather than from management.

5.285   The types of corrective action that may be available include the following:

   (a) Changes to procedures;

(b) Changes to the processing systems;

(c) Retraining or additional training;

(d) Reminders about particular procedures sent to staff;

(e) Changes to coding indexes in processes where they are used.

5.286   The second part of step 4 is to continue to measure quality and evaluate the effectiveness of the corrective action that has been implemented. As the most important quality problems are resolved, the cyclical approach is continued and the next most important set of problems is targeted. This results in the quality of the process being continuously improved.

7.   Validation

5.287   The purpose of validating census data is to identify system problems and ensure data quality for final output. It is the final check to ensure that the data produced by the processing system meet the specifications of the editing program and output requirements.

5.288   Validating the data before they leave the processing centre ensures that errors that are significant and considered important can be corrected in the final file. This final file can then be used as the source database for the production of all dissemination products. It is important that all products be created from the one source file. Changes to the source file after validation can result in products being produced from different source files, which may have an impact on data and product integrity.

5.289   While it is the final check of data, validation should not be viewed as the last process in the processing cycle. It is vitally important that validation be a continuing and parallel process to all other processes. This allows for the early detection of problems and subsequent implementation of fixes to either processing systems or procedures. In this way, validation has the same aim for the processing system as that for the final data. This ensures that the stages in the processing system are producing output as specified, and as required for the next system. In this way, validation contributes to continuous quality improvement of both the system and the data.

5.290   It is also important that a validation process be included in any processing tests prior to the census. Validation of the data in these tests will allow early detection of system problems (such as edits) before the processing system is commissioned for the census. The role of validation in improving the processing system is even more critical in the testing stages. The early detection of problems allows for a more thorough examination of the problem, and development and testing of fixes, than can be undertaken during census processing. Problems found during census processing are subject to the conflicting priorities of timeliness and cost. Therefore, the decision may have to be made to correct the data alone, without correcting the process.

7.1   Defining the data items

5.291   In conjunction with the census dissemination area and other stakeholders, the specification of the output data items to be validated should be determined. Each data item is defined for the legal values to the output classification, what constitutes "not applicable" categories, and any specific data combinations that are mutually exclusive.

5.292   In addition, known data problems from previous censuses, or arising from the feedback received from the enumeration activity, are identified and procedures for checking them are defined.

7.2   Defining the method

5.293   The procedures and methods for validation must be defined to ensure coverage of problems and consistency of approach. Each time the data are corrected or changed for some reason, they should be validated, following the same procedures, to ensure that the error has been corrected and that no new problem has been created.

7.3   Aggregating the data

5.294   All data items should be checked for consistency and accuracy for all categories at a number of levels of geographical aggregation. As validation should run parallel to the other processes, it should commence with the first enumeration areas that complete processing, and continue with larger aggregations of data as they become available for validation. These aggregations will eventually comprise entire geographical regions, as defined for the country (for example, regions or states).

5.295   This ensures that data are checked a number of times, and also ensures that larger table populations are checked. This is essential, as small table populations may not fill all cells in a table. Therefore, data errors, and the processing problems that produce them, may go undetected until a large amount of data is available. By the time a large amount of data is ready for validation, some initial processes may have already been completed and the opportunity to correct the process where the error was created has passed or is considered not worthwhile, given time and financial constraints.

7.4   Comparison with other data and intercensal change

5.296   Where possible, it is beneficial if data items in both census data and recent surveys can be compared. This is particularly important if the comparable data items have been collected in a recent survey or are available from administrative by-product collections. This can give indications of expected changes, or provide an explanation of changes or movements detected in the census data.

5.297   When validating intercensal change between current and previous census data, it is useful to specify tolerance levels for changes in the data items. For example, this may involve setting a tolerance level of plus or minus 5 per cent in population growth for a particular geographical region. This tolerance level can be based on expected normal rates of

population growth in these regions. Any growth outside this range would signal the need for more detailed investigations into the reasons for the growth or decline.

5.298   Changes in the components of the workforce, or in the types of industries and occupations in which people are employed, occur over time in all economies. Having some background knowledge of what sort of changes may be expected in the data, and where they may occur, is part of the validation process. This ensures that the data released for dissemination have been checked to ensure that they reflect what has actually occurred. This is particularly critical in areas of population growth or decline, where the census data are required for equitable distribution of funds and electoral distribution.

5.299   The final validated data released from the processing centre should be complete, with details of any changes in the data that may be problematic for users.

7.5   *Regional office participation*

5.300   Some census agencies will have regional offices spread throughout the country. These offices may have a better knowledge about their particular geographical regions. This expertise can be used in the validation process, as follows.

(a) Advice from regional offices can be sought before processing starts to identify any known changes that will affect the comparison of census variables. These changes may include population shifts, ethnic clusters, new housing developments or regional employment changes such as the opening or closing of a large employer.

(b) Determination can be made as to whether the level of growth or decline of population and dwellings in the census is in line with projected growth or decline. This can be done through checking census counts of persons and dwellings at the smallest geographical level of output (enumeration area), as well as for aggregated areas (statistical regions or administrative areas).

VI. Census products, dissemination and utilization

A. Introduction

6.1   The population and housing census is a statistical operation of exceptional value to every country.[73] It is the primary source of basic national population data for public administration and for many aspects of economic and social planning. Consequently, data from national censuses represent a valuable public good that should be widely promoted by national statistical and census offices in order to enhance its utilization by the various users. Thus, the census should not be an end in itself but should be backed by the value of the results, in terms of utilization, and by the diverse categories of data users.

6.2   The purpose of the present chapter is to provide a more specific elaboration of the data dissemination strategy to assist census managers, operatives and practitioners overseeing the development and release of reports, publications and data products using census statistics. Managers can use the chapter as a guide for planning, executing, monitoring and releasing census products.

6.3   Timely and quality census data are indispensable for informed decision-making, development planning and better implementation outcomes. Specifically, census data are instrumental in understanding development challenges and the appropriate actions for influencing and informing change in relation to socioeconomic progress and environmental phenomena. Census data must therefore be transformed into usable formats to respond to the needs of stakeholders, while at the same time protecting the confidentiality of data.[74]

6.4   For some countries, the fundamental paradigm shift in the 2020 round of population and housing censuses is the utilization of statistics to increase public knowledge related to the progress of society and for transparency, mutual accountability and governance, results-based management and transformation. The role of statistical leadership is to anticipate and define the measurement of policy questions. The increased use of statistics by Government, business and the citizens at large will drive different and better results and thereby succeed in mobilizing society for change.[75]

6.5   In designing and developing census products for the 2020 round of population and housing censuses, it is necessary to take into consideration the statistical framework of the 2030 Agenda for Sustainable Development, in particular the list of indicators modelled for monitoring the implementation of the Agenda. The final list of these indicators was not

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[73] The present chapter focuses on managerial issues related to the development and production of different census products. It should be read in conjunction with the more elaborate recommendations presented in the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, part three, chapter X, on census products, data dissemination and utilization. For ease of reference and flow of the material, selected text from chapter X is reproduced and incorporated in this section.

[74] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.235.

[75] Ibid., para. 3.236.

available at the moment of drafting the present handbook;[76] however, as it will become available well in time for the preparations of the census products for the 2020 round of censuses, all efforts should be put in place to produce census statistics in line with those indicators.

6.6   The present chapter begins with a discussion of the broad strategy for the census product phase, which includes guidance for preparing the strategy, project management, quality and risk, managing resources and policy considerations. After planning comes the user consultation process occurring before, during and after the development and release of products. Next is product development, which includes such topics as understanding the audience, protecting confidentiality, and special considerations for specific dissemination products (e.g., tabulated, geographic, analytical and Internet-based products). The focus then shifts to product dissemination and promotion, including such topics as quality assurance, branding, public relations, special promotional products, customer service and closeout.

6.7   Throughout the present chapter, the terms "services" and "products" may be used interchangeably. This reflects the fact that, in many cases, there is an arbitrary choice by the census agency as to whether a range of data are provided through a specific (usually, generally available) product or by a value-added service.

B.   Dissemination strategy

1.   Introduction

6.8   A wide range of dissemination strategies must be developed for meeting the requirements of different users. Appropriate technology and media need to be identified for the effective and easy dissemination of census data and information. A number of key elements should be taken into account in the development of a strategy for census data dissemination, including: (a) identifying the diverse categories of users and their data needs and uses; (b) consultation; (c) products to be developed; (d) the media of dissemination; (e) metadata to aid in the interpretation of the results; (f) confidentiality and privacy measures; (g) assessing the technology required to meet user needs; (h) dissemination policy; (i) quality assurance in terms of accuracy and timeliness; and (j) available financial and human resources.[77]

6.9   The census agency will need to balance the needs of many stakeholders during the planning, development and release of census products. For example, data users expect a high level of accuracy in the information provided by an official census agency, and they will also expect the data to be released in a reasonable time frame after completion of the census enumeration. Furthermore, managers will probably receive pressure from key stakeholders

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[76] November 2015.

[77] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.242.

(such as sponsors and government agencies) for prompt access to data, for the data to be of indisputable quality and for the census agency to control costs.

6.10   Managers are encouraged to use internationally recognized project management principles to increase the likelihood that the product phase meets its goals, stays within budget, and is concluded on time. In the case of official statistics, GSBPM, Version 5.0, provides essential guidelines and a project development framework.[78]

2.   Meeting users' needs

6.11   The demand for and use of statistical products and services must drive all census operations. National statistical and census offices should have a sound strategy for developing suitable products and services to respond to the diverse needs of data users so as to promote the utilization of census results. Such strategies should be based on an active dialogue with the users regarding their needs in terms of products and the format of those products.

6.12   The user consultation process in terms of census products is a major factor in the development of a dissemination programme. The type of consultation discussed in the present section complements the consultation undertaken to determine census content (see chap. II, sect. G). The work done at this stage of the census is important in achieving the objective of ensuring that that the census is relevant to users, which is a major indicator of the quality of the census. The selection of suitable census data products and related services should be guided by a detailed assessment of user requirements.

6.13   Plans for what and how products will be disseminated should be made early in the planning process and shared with potential users in order to get their feedback. On the basis of this feedback, the national statistical or census office can tailor its data dissemination programme to suit the requirements of the users. Maintaining good communication and obtaining feedback from users are also important for making modifications to products and services, including to respond to user requests that become known later in the programme.[79]

3.   Products and media of dissemination

6.14   At the level of the census dissemination strategy, the census product phase will need to be managed from two perspectives: (a) as a phase of the overall census programme; and (b) as a set of individual products.

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[78] Available from https://statswiki.unece.org/display/GSBPM/GSBPM+v5.0. From a more general perspective in terms of project management, there are other references, such as the Project Management Body of Knowledge, an internationally recognized standard that provides fundamentals of project management. See, for example, https://www.projectsmart.co.uk/pmbok.php.

[79] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paras. 3.243–3.245.

3.1 Product phase life cycle

6.15 This section discusses the product phase in the context of the overall census programme and strategy. It follows the life cycle laid out in table 23 and figure XVII, starting with product planning and then proceeding to development and dissemination. User consultation occurs throughout the entire product phase (and indeed, the entire census programme) and should not be treated as an activity with a distinct start and end. Monitoring and evaluating are also continuing processes.

Table 23

Stages of the product phase

Stage	Components (not exhaustive)	Timing
Planning	• List expected products • Establish high-level release schedule • Set budget and resources • Determine quality standards • Prepare dissemination strategy • Account for risks	At least one year prior to census date until beginning of product development
User consultation	• Identify users and stakeholders (see chap. II, sect. B.2) • Determine questions to ask • Proceed through phases of consultation	Continuous
Monitoring and evaluation	• Track progress towards quantifiable goals • Adjust workflows if the situation changes • Use change control procedures if necessary	Continuous
Development	• Plan and create individual products • Identify a dissemination medium • Understand the audience, remain neutral and protect confidentiality	During census planning to two or more years after census date
Dissemination	• Thoroughly review the products before release • Ensure products meet branding standards • Promote products widely and provide customer support	When products are finished; six months after census date and beyond
Closeout	• Ensure deliverables have been met • Document lessons learned	When all products are released

	• Archive materials for next census	

Figure XVII

Product phase life cycle

Monitoring and evaluation

User and stakeholder consultation

Planning	Development	Dissemination	Closeout
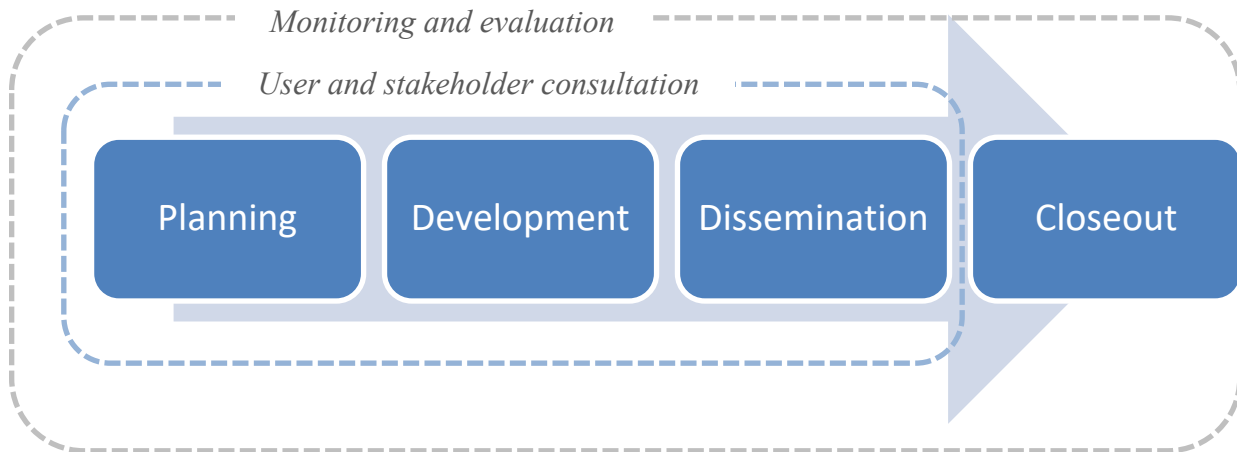
3.2   Individual product life cycle

6.16   Each individual census product proceeds through a life cycle similar to the life cycle of the overall product phase. However, the beginning and end of each product is usually clearly defined. Each product begins with a broad conceptualization of its purpose, merit and potential sensitivities. From there, the product proceeds to the proposal stage, where the methodology is laid out and reviewed before work begins. These two stages are key to avoiding problems in the next stage – production – where most time is spent creating the product. Once the authors are satisfied with their product, the item proceeds to review by middle and senior managers and independent subject matter experts seeking to correct errors and ensure neutrality. Once the review conditions are satisfied, the product is released (table 24).

6.17   While most time in the individual product life cycle will be spent during the production stage, arguably the most important stages come beforehand: concept and proposal. These planning and preparatory stages should identify major methodological problems early in the process and reduce the risk of significant delays or cost overruns later. The review stage is also critical, since product authors will benefit greatly from an outside perspective. Furthermore, the review stage is the last opportunity for managers to correct errors before release. If products are released in an unpolished format and with errors, they will reflect poorly on the census agency.

Table 24

Individual product life cycle

Stage	Description	Staff role	Manager role
Concept	The lead product authors prepare a high-level conceptualization for the product they wish to develop. The concept may be quite broad and does not require detailed planning at this stage. Examples of information to include in a concept: product title, purpose, data sources, author names, and any potential sensitivities (political, methodological, etc.) regarding the product.	Draft concept and request managerial approval	Determine if concept aligns with the mission of the agency and either approve or deny
Proposal	After receiving concept approval, the lead product authors write a detailed proposal outlining the scope, schedule and budget of the product. This proposal should lay out the purpose of the product, the primary audience, the detailed methodology to be used, and the product dissemination medium, and should list all involved parties within the census agency or externally. Any potential sensitivities discussed at a high level in the concept phase should also be explained thoroughly.	Prepare proposal and present to managers for detailed analysis of feasibility and sensitivity	Determine if proposal is reasonable given the availability of resources and either approve or deny Also, ensure methodology is sound to avoid problems during production phase
Production	The product is developed using the defined methodology. During production, all assumptions and workflows should be documented for later reference. Technical documentation to accompany the product is prepared concurrently. Any adjustments to the methodology should be reviewed using established change control procedures (for more information, see B.4.d change control).	Work on product using methodology outlined in the proposal Adapt methodology if necessary, but consult managers	Monitor progress on a regular basis and ensure product remains on schedule, within budget, and within the defined scope
Review	After the authors are satisfied with the quality of their product, they submit the product for internal review. The review procedures should include at least one senior manager and one internal subject matter expert not involved in the development. The primary objectives at this point are to identify and correct errors, ensure the product meets quality standards, and validate the methodology.	Review product thoroughly before passing along to management	Work with authors to ensure final product adheres to agency standards Identify errors for correction

Release	Once the review conditions have been satisfied, the product is released publicly or to its defined audience.	Promote product widely and be prepared to field external questions

4.   Confidentiality

6.18   In terms of overall census dissemination strategy, ensuring the confidentiality and privacy of census data has a critical role in accordance with principle 6 of the Fundamental Principles of Official Statistics: "Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes."[80] Maintaining data confidentiality is an indispensable element of maintaining the trust of respondents. If respondents believe or perceive that a national statistical or census office will not protect the confidentiality of their data, they are less likely to cooperate or provide accurate data. This in turn affects the accuracy and relevance of the statistics.

6.19   The ever-increasing demand from users for more data, especially microdata and at lower geographical levels, and also with more technological advancement for data linking, in particular over the Internet, has created more challenges for managing data confidentiality. As a result, national statistical and census offices should examine the data and make modifications, when necessary, prior to dissemination of the data. The objective of the modifications is to prevent identification of individual respondents, and also intentional or inadvertent disclosure of their personal information. This is the case in particular when microdata are disseminated and when data are linked to location, such as with the use of GIS.[81]

6.20   Consequently, incorporating procedures for protecting confidentiality and privacy of data has to be consistently taken into consideration throughout all the steps in preparing census products and data dissemination. A more detailed elaboration is provided later in the present chapter.

5.   Stages of data release

6.21   The release of data and census products needs to be determined and publicized well in advance of the census itself. This allows users to plan their activities related to the use of census statistics accordingly and appropriately.

6.22   It is common to have several steps and sequential data releases as they become available, depending on the processing and, especially, coding issues. Therefore, the release needs to be segmented out accordingly, taking into consideration that certain characteristics are of more immediate interest to users than others. In a number of cases, a census has released the preliminary total counts based on supervisors' aggregated daily totals during the

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[80] http://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx.

[81] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.288.

enumeration. These preliminary data issued soon after the enumeration are of particular importance to the population at large, as they document the census while it is still a fresh and recent event.

6.23   The steps in the release of census products will also depend not only on the processing but also on the complexity of the product and the need for data validation. If a high level of analysis is a considerable component of the census product, additional time will be needed for preparation and subsequent release. Similarly, if the product itself involves sophisticated technological solutions, it will also require extra time for testing and quality assurance.

6.   Coordinating release of census results with other statistical products

6.24   The wealth of data provided and offered by the population and housing census tends to overwhelm other statistical products issued by the same agency. In addition, the large number of social and economic phenomena covered by the population and housing census may appear to make other statistics redundant.

6.25   Therefore, it is imperative to link the release of census products with other statistical products that would provide additional depth to census statistics. For example, census results on the economic activity of the population can be referenced to the most recent labour force survey results, or the household composition statistics from the census can be complemented by the results of household consumption surveys, and so forth.

6.26   The coordinated release of census and other statistical products by the statistical office has the additional value of promoting not only the census but also the overall activities and results of the official statistical agency. It will also provide a more comprehensive source of numerical profiles of the population and living conditions in general. Equally important is the explanation of discrepancies, if any, between census data and those from other statistical products, thus preventing possible controversies related to those discrepancies.

C.   User consultation process

6.27   It is important for census offices to consult data users and identify their needs in order to proactively anticipate the type and format of census products to be produced. This is to ensure that census products are relevant, responsive and add value to the current policy questions and stakeholder needs.[82]

6.28   The essential purpose of the user consultation process should be to inform census users of the census agency's strategies for developing the products and services of the forthcoming population and housing census. It should also seek their views on the strategic goals and directions for the census product phase. This overall aim can be broken down into three objectives:

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[82]Ibid., para. 3.247.

(a) To better understand overall user reactions to the current direction of the dissemination phase;

(b) To understand user reactions to specific products and services;

(c) To report on the outcome of dissemination research and make recommendations to users and census agency management for census products.

6.29 The user consultation process discussed in the present chapter complements and builds on previous discussion of user consultation prior to finalization of the census questionnaire content (see chap. II, sect. G).

1. Identifying users and stakeholders

6.30 In broad terms, the market for census products and services can be defined as any person, organization or business enterprise interested in demographic or socioeconomic information. This may be for the community as a whole or any group within the community, or for a particular geographical location. Examples follow of users and stakeholders that should be consulted.

1.1 Market research

6.31 For the purposes of the population and housing census, market research can be defined as any organized and structured effort to gather information about target users and uses of census statistics and results. Market research should be conducted throughout the census product phase. This will allow the census agency to review and refine the products until the proposed output meets a majority of users' needs.

6.32 Market research prior to the development and design of a product or service is essential to ensure that output aligns with the needs of the user community. Market research can monitor the performance of products and services; measure and analyse user attitudes; and gather information to feed into the redesign of products and services and potentially lead to the development of new products and services. In many cases, appropriate information may already exist in previous research by the census agency (which can include user consultation).

6.33 While market research should commence well before the enumeration period, it may be possible for detailed product design (for more complex products) to be undertaken during the census data-processing period. However, the detailed design of the basic output products should be completed in sufficient time to minimize the lag between completion of validation of processing and release of the product.

1.2 Users versus stakeholders

6.34 For the purposes of the present handbook, users are defined as individuals, institutions, agencies or organizations that will apply the products of the census to their work in some manner. These users are variable in terms of interaction with the census agency, from the student casually using census results to the minister of another government agency

actively involved in the questionnaire design. When evaluating the needs of users, the census agency should consider the broadest possible community but focus efforts on the larger communities, either in terms of number of users or impact on the agency's budget.

6.35   Stakeholders, on the other hand, may or may not use the data products of the census agency. Regardless, they have the ability to influence, positively or negatively, the well-being of the census or the entire agency. For example, a key stakeholder who may not use census data directly could be a politician with influence over the census budget. The census agency should identify stakeholders early in the product planning process and should objectively rate them in terms of their ability to influence the census product phase. Stakeholders rated as highly influential should be regularly consulted and informed of the progress of the product phase to maintain their support of the project.

6.36   Of particular importance is the general public as a key stakeholder in the census. Without the active participation and support from the population at large the census may fail. At the same time, the public at large is also a major user of census data, especially those directly linked to their immediate surroundings (village, town, city, or other unit). Thus, to engage the public at large and demonstrate the value of the census, a key component of the dissemination strategy should include the release of data of interest to the general public.

6.37   When identifying users and stakeholders, managers need to search both internally and externally. Internal users could be classified as within the census agency, within the same ministry as the census agency (if organized in such a manner), or within Government. Importantly, users or stakeholders within the census agency should be involved in all phases of the consultation process. They should be given the opportunity to reply to questionnaires and participate in the detailed product proposals at the contemplative stage. Focus groups and workshops for internal users provide an effective forum for innovation and generating proposals for new products, as well as providing internal staff with the chance to have input into the final product design.

1.3   Types of users and stakeholders

6.38   The users of census data and stakeholders in the product phase can be broken down into several broad (and not necessarily mutually exclusive) categories. These categories are defined primarily on the basis of usage of census data or ability to affect the success of the census. Table 25 provides a summary of the characteristics of the various types of users, while box 30 gives an example from the 2011 census of South Africa of census user segmentation.

Table 25

Types and description of census users

Type of user	Description
Key users	As with influential stakeholders, key users are important to the census agency from a strategic and business point of view. It is important that the agency establish and maintain a close relationship and regular contact with these users. The client service logic that underpins this group includes a combination of understanding, empathy and sharing of user needs. Flexible, creative solutions should be used that call upon the full capability of the organization to service those needs. The key user segments include government departments, educational institutions, finance and other business sectors, market research consulting sectors, and academic research institutions. **Lifeline users.** A special category of key users is the "lifeline" users. These users are defined as strategically important organizations that have the potential to influence continuing political or opinion leader support for the agency or contribute significantly to revenue or funding. Depending on the national circumstances, these can refer to the Government in general or key ministries in particular, as well as representative bodies and local governments.
Subscribers	These are users that regularly do business with the agency but usually in a repetitive manner and whose needs are for the most part satisfied through the regular supply of standard products and services. The client service logic that underpins this group includes reliable, predictable and consistent service, supported by a loyal, stable and long-term relationship. The subscriber segment comprises users subscribing to publications and other standard, regularly released products or services such as online statistics.
Ad hoc users	These are users that make occasional or one-time contact or whose requirements are easily met through the provision of individual products or customized services. The client service logic that underpins this group includes quick, reliable, predictable, consistent, responsive, informative and accurate service.
Competition users	These are users that have a number of choices to satisfy their information needs. Potential competitors may include market research organizations that are able to tailor their services to satisfy the needs of individual users; consultancy service providers that are able not only to provide data but also to conduct analysis and interpret results; or secondary distributors that either distribute census data or package the data into applications developed for user-specific needs (for example, client profiling and location analysis). Depending on the revenue model for the census agency, competition users can be seen as either a threat or an opportunity to the agency. Census agencies may wish to cooperate with competition users to broaden the application of census products and increase awareness of their usefulness.
Media sector	There is a need to have strong and coordinated links with the working media to promote broad public awareness of the agency and its products and to contribute strongly to public good outcomes. This sector may be dealt with as part of media liaison through a public relations unit within the agency. Strong media relationships can produce a widespread positive image of the census agency within the country.

Box 30. Census user segmentation: 2011 census in South Africa

Statistics South Africa used the tagline "The South Africa I know, the home I understand", which speaks to the use of statistics for evidence-based decisions by stakeholders, whatever their role in society. For the 2011 census, the following user stakeholder segmentation model of the target audience was used, based on the Australian Bureau of Statistics model of users.

Using such a framework the type of product and data complexity required by the different target audiences were defined, including the channel of communication.

Source: Statistics South Africa.

Box 30. Census user segmentation: 2011 census in South Africa

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Specialist information consumers — Analysts / Statisticians / Researchers — **MINERS** Specialist service

Specific information consumers — Government / Educators & schools / Business & NGOs / Researchers & academics — **HARVESTERS** Self service

General information consumers — Community users & CBOs / General public / Learners — **TOURISTS** Direct service

MEDIA — Mainstream / Social media

Using such a framework the type of product and data complexity required by the different target audiences were defined, including the channel of communication.

MARKET GROUP	DESCRIPTION	COMMUNICATION PROFILE	TYPE OF PRODUCT
MINERS Analysts, Statisticians, Researchers	**Specialist consumers** Information professionals, technical people: **detailed self services**	Academic / statistical language **Channels:** Internet	ADVANCED Interactive user defined tools; Detailed methodological guides
HARVESTERS Researchers & academics, Business & NGOs, Government, Parliament, Educators & schools	**Specific consumers** Key target groups / clients professionals: **simple self services** **target specific products**	Context / application specific **Channels:** Internet, Print media	INTERMEDIATE User-friendly interactive products; Pre-generated products for specific need
TOURISTS General public, Community users & CBOs, Learners	**General consumers** Ad hoc users basic statistics: **user service**	11 official languages **Channels:** Cell / smart phone Radio & TV Print media	BASIC Simple, easy to understand standardised info e.g. graphic visualisation; Statistical stories
MEDIA Mainstream Social media	Educate mainstream media as communicators; Make data freely available social media for e.g. data- and map mashing, google data etc.		

Source: Statistics South Africa.

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2. Phases of consultation

6.39   The user consultation process can take place in three phases, some of which will overlap: qualitative studies, quantitative studies, and detailed product design.

2.1   Qualitative studies

6.40   The aim of the qualitative research is to better understand the reactions of users to the current census dissemination programme, including products, services and their delivery. This contributes to recommendations for the next census dissemination programme. The major tasks are as follows:

    (a) Prepare detailed specifications;

    (b) Contract external consultants;

    (c) Organize focus groups;

    (d) Prepare interim report (for the evaluation phase);

    (e) Prepare final report.

6.41   Qualitative studies are most commonly undertaken in the form of focus groups (that is, small group discussions moderated by a market research specialist or facilitator). Focus groups can provide qualitative information about the performance of current products and services. Detailed current product plans provide the starting point. The groups are usually general in nature, covering a range of users and products. However, there may be the need for more specialized groups to deal with key user communities, as well as with individual high-profile products.

6.42   Where appropriate, larger-scale conferences workshops can be held to allow consultation with users from a broader community. Such conferences should be organized with a clear agenda and a list of required outcomes or decisions.

6.43   External consultants can be employed to assist in this process. However, the census agency must remain closely involved in the development of the specifications to be provided to the consultant.

2.2   Quantitative studies

6.44   Quantitative studies may make use of user mailing lists that have been built up by the census agency over the past census cycle (for example, customer databases and email newsletter subscriber lists). A variety of questionnaires may be required, including a general questionnaire and others focusing on:

    (a) A particular product or service;

    (b) Particular market segments or industry sectors;

(c) Users' technical requirements (available formats and media and industry standard software in use).

6.45   The major tasks in the quantitative research phase are:

(a) Determine detailed methodology;

(b) Develop questionnaires, covering letters, newsletter articles, response mechanisms;

(c) Conduct surveys;

(d) Analyse and prepare reports.

2.3   *Detailed product design*

6.46   On the basis of the results of the qualitative and quantitative studies, the census agency will need to make decisions on the appropriate product mix. Within the census office, approval should be sought for detailed product design, along with submissions for appropriate funding (where this is required from government funding rather than being obtained through user-pays arrangements).

6.47   Prototypes of the various products can be prepared and follow-up user consultation undertaken through seminars and digital feedback (for example, by email). Consultation will also need to take place on the classification details that users require from the census, some of which may have an impact on the final census questionnaire (see box 31 for an example from the United Kingdom).

6.48   The major tasks in the detailed product design phase are:

(a) Determine overall product mix;

(b) Develop product plans for corporate approval;

(c) Develop prototypes;

(d) Devise classification proposals;

(e) Consult users;

(f) Finalize product design.

Box 31. User consultation for census products and services: 2011 census in the United Kingdom

From the first release of the 2001 census results onwards, the Office for National Statistics has actively sought feedback on all aspects of census outputs. Extensive consultations were held to define a range of 2011 census products and services that would meet the needs of users, covering both those users who wished to obtain a broad overview for a particular area, and the more experienced users who required very detailed and specific information about a particular topic. In 2008, a 12-week census output consultation was carried out by the three United Kingdom census offices via an online survey. The aim was to find out what potential users of the 2011 census wanted from the data collected, and to help the Office for National Statistics in

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particular to prioritize identified output needs, with a focus on high-level output issues. Topics covered included products, access, dissemination and metadata. A consultation programme on the statistical outputs was then carried out to establish the extent, scope and detail that users would like to see from the 2011 census. The consultations on main statistical outputs had two distinct phases, running from 14 December 2009 to 26 March 2010, and from 7 February 2011 to 28 April 2011. These phases included formal consultation feedback documents for completion and return, and were supported by national public consultation events as well as direct engagement with key users and user groups. All views received were considered and analysed.

Source: 2011 Census England and Wales General Report, Office for National Statistics, United Kingdom, 2015.

3.   Questions to ask

6.49   The feedback received from users must be guided by focused questions relevant to the agency. Much like census questionnaires, users should not be asked questions that do not have a specific purpose. The following sections will help to guide census managers in soliciting specific feedback from users.

3.1   Lessons learned from the previous census

6.50   An evaluation of the method of production from the previous census should be conducted to identify successful elements in the product phase that can be carried over to the current census. More importantly, problem areas need to be identified to improve the process. The census agency can then proceed to the user consultation phase and use such information as a baseline for adapting the range of products and services to meet current and emerging needs in the user community. These needs can only be identified in the consultation process.

6.51   Ideally, at the conclusion of the previous census, managers evaluated and documented the successes and failures of the product phase in a document on lessons learned. If such documentation is not available, it is still possible to identify parts of the census product phase that require improvement or that need special attention by interviewing managers and other staff present during the previous census.

3.2   Consultation on broad directions

6.52   The consultation process can be carried out in two stages. The first is consultation on the broad directions of the dissemination phase. The dissemination strategy should be provided in publication form, accompanied by a user feedback questionnaire. This first publication can provide the goals, the strategies to achieve the goals, and the broad directions of the dissemination phase. The self-enumerated feedback questionnaire can comprise two parts:

(a) Questions relating to the user's interest in existing census products and services, with a specific accent on information needs, not just output types such as tabulations;

(b) Questions relating to the strategies proposed by the census agency for the products and services of the next census.

6.53   Users should also be asked whether they wish to be involved in later rounds of the consultative process.

6.54   Much of the information sought in this stage will be qualitative commentary. Information may be available on the quantity of products accessed by each user. This information can be used to develop some weighted measures of the strength of views according to the nature of the user.

3.3   Consultation on specific products and services

6.55   On the basis of the results of the broad consultation, more specific proposals can be developed. A second publication and feedback questionnaire can be supplied to users that expressed interest in further consultation. This publication presents the proposed content of products and services that will become available and estimated release dates. The feedback questionnaire can seek detailed information on the content of specific products. In addition to analysing the user feedback questionnaires for the purpose of assessing the plans for the product phase, the returned questionnaires can be further analysed by users' industry (for example, Government, academia, market research, energy) or status (for example, heavy user, ad hoc user).

6.56   In addition to the publications and questionnaires, in-person sessions can be conducted with key users, where possible, to obtain more detailed feedback.

3.4   Common topics and issues

6.57   The range of issues to be covered under this heading is broad and will be determined by many factors, including the range of topics on which data are to be collected, and the strategic issues covered in section B above.

6.58   Table 26 presents issues commonly raised by census users and stakeholders concerning the data products, software applications and services delivered by census agencies. This list is not comprehensive, but may be of assistance to countries in planning the user consultation process. Census agency managers should consult users on all of these topics to increase the likelihood of a successful census product phase.

Table 26

Common issues in data products

Issue	Considerations
Relevance, usefulness and appropriateness	This information should be of great value to the census agency in determining the priority afforded to specific products. Information collected under this topic will need to be integrated and compared with that collected under other

Issue	Considerations
	items in this section. It is, however, a key measure of the relevance of the data or product under consideration.
Presentation, formatting and accessibility	Consulting census data users is important when choosing a medium for accessing a product. Users can communicate to the census agency their preferred format for receiving data. Such communication can save users a substantial amount of time for potentially little additional effort by the census agency. For example, if users use spreadsheet software to analyse census data, they may prefer to receive the data in a structured format, such as CSV-delimited text file. However, if the census agency disseminates the data as a portable document format (PDF) table (as is common), the user may be frustrated since they cannot easily translate PDF tables to spreadsheet software.
Quality	A key decision about the quality of census results will be the trade-off between timeliness and quality. This is particularly important in designing the output strategy, in that the decision affects not only the dissemination team but also all the preceding stakeholders in the census programme. Quality thresholds should be explained to users in conjunction with the issue of timeliness (below).
Timeliness	Many users of census data have unrealistic expectations of the timeliness for release of accurate census data. An important role of managing a census is to manage users' expectations of this aspect of quality so that the output programme is not threatened by unreasonable demands for early data. The time required to undertake the following activities should be drawn to users' attention: • Transporting materials; • Capturing, coding, and editing the information from questionnaires; • Compilation of the output files and preparation of products; • Data validation and quality assurance.
Pricing (if applicable)	To some extent, the issues raised by pricing will be predetermined by the policies applicable in a country. Within this broad set of parameters, users' reactions to pricing are likely to vary according to their circumstances and their view of the official policies. However, these views can be influenced by a number of factors, including the following: • Whether the need is for a standard product or a customized service; • Timeliness of the product or service; • Comprehensiveness, accuracy, breadth and relevance of the data included in a product or service;

Issue	Considerations
	• Scope and content of the product and the range of media in which it is disseminated; • Level and effectiveness of the training and support provided; • Breadth of functionality of the software (where applicable), and its quality and performance.
Customer support	Customer support refers to the services that the census agency may provide to support users in their application of the data or use of the product. This may range from an enquiry service to a product support facility similar to that offered by computer software companies. Support and training can be provided on the basis of data products or on the use of software products of the census agency. The level of sophistication will depend on the funding available to the census agency and the needs of users.

D.   Broad product strategy

1.   Scope of products

6.59   A wide range of statistical products can be made available to the public, the private sector, government agencies, local authorities and the academic and research communities. The types of output that census offices may produce and disseminate must be current and may include printed products, static electronic products, interactive electronic products, customized products and special audience products and services. Partnerships with key stakeholders are encouraged in the development of the various census products.[83] The range of census products and services to be developed should be predicated on user demand in response to the results of the user consultation process (see section C above for more information on user consultation). Although census data products should cater to the needs of as many users as possible, each of the products should have an intended audience.

6.60   Standard census products may include tabulations on characteristics such as age, sex, fertility, mortality, education, language and income. Other standard products could include geographical data sets or public use microdata samples. The definition of products considered standard to the census agency should be established in close consultation with data users and key stakeholders.

6.61   The census agency will probably receive requests for non-standard information, special tabulations, and consultancies on data use. These requests may come from government agencies, the private sector or other interest groups. To fulfil these requests, the census agency can either provide customer service directly to users or contract with a private organization.

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[83]Ibid., paras. 3.248 and 3.249.

6.62   The census agency itself best understands the data and their limitations and can thus provide the most effective service to users. However, the costs to the agency of user liaison may be higher than if such services are contracted out. For example, it may be necessary for the census agency to hire staff such as software developers and customer service specialists. From a census management perspective, it is important that workplans and budgets make appropriate allowance for these tasks. These decisions should be made as far as possible in advance of census day and, as stated previously, the user community should be consulted frequently to ensure their needs are met.

6.63   Table 27 presents an example of census data products from the 2011 census in Australia.

Table 27

Census data products for the 2011 census in Australia

Product	Ease of use	Attributes
QuickStats	*	Enable quick and easy access to summary information about people, families and dwellings in an area.
Community profiles	**	Provide a comprehensive statistical picture of an area, detailing characteristics of people, families and dwellings. They cover most topics from the census form and can be used for research, planning and analysis.
TableBuilder	Basic ** Pro *** ($)	An online tool designed for users who have a knowledge of census concepts and some experience using census data. Basic or complex tables can be built at any geographical area level, ranging from a single statistical area level 1 (SA1) to the whole of Australia.
DataPacks	***	Suitable for experienced census data users who have their own database or analysis systems. DataPacks contain data for the main census characteristics of people, families and dwellings for geographical areas ranging from SA1 to the whole of Australia.
Census sample file	*** ($)	A confidentialized sample of census unit record data for modelling and analysis.
5% statistical longitudinal census dataset	*** ($)	Brings together data from the 2006 census with data from the 2011 census and future censuses to build a picture of how society moves through various changes.
Customized data services	($)	Where data are not available from the Australian Bureau of Statistics website at the level of detail required, the information consultancy service may be able to provide customized data to meet specific requirements.

Notes:

* Easy-to-use product.

** Intermediate product: requires understanding of census concepts and skills in building tables with statistical data.

*** Advanced product: requires detailed understanding of census concepts and statistical analysis skills.

$ Charge applies.

2.   Product development and release schedule

6.64   To ensure predictability of release (that is, the announced release dates are adhered to), the census product dissemination programme's schedule must be carefully considered so that it is realistic and achievable. The schedule should be built in close consultation with internal and external stakeholders and include every product planned for development and release. Release dates should be established internally early in the census-planning process and announced publicly with sufficient notice.

6.65   To effectively control the schedule and distribute workloads, managers should consider splitting the release of primary census results into two or more stages. The majority of users should be satisfied by an initial release of basic data followed by a subsequent release of ancillary data. The basic data are usually limited to headcounts tabulated by large geographical areas and core demographics (for example age or sex). More complex topics that may require considerable processing resources, such as industry and occupation, could be included in later releases.

6.66   Where the resources of a census agency are limited, the optimum strategy may be to focus a higher proportion of resources on the initial release of basic data. Other entities, such as value-adding external agencies or the private sector, could help to meet more complex data needs.

6.67   Another strategy is to release *provisional* results in advance of final results that may be subject to some adjustments later. This strategy should be used carefully to ensure the final results do not deviate by a substantial margin from the provisional results. Managers should also carefully monitor the methodology used to produce provisional results and work closely with their subject matter experts to ensure statistical quality standards are still being met.

6.68   Managing the census product release schedule requires consultation with users to determine which data items are required close to census day, balanced by the census agency's knowledge of the items that are difficult (and thus time consuming) to process.

6.69   Regardless of the strategy chosen, a schedule should be developed and monitored to cover the key phases of the dissemination programme and major product releases. This schedule is essential to ensure key activities are completed on time. Regular progress reviews are recommended to uncover problems that may arise, which allows for corrective action. Any problems that have the potential to affect the schedule should be identified and solutions put in place as soon as possible.

6.70   In particular, where agencies have distinct groups of people responsible for the various tasks associated with product development, it is important to identify dependencies

and to put in place communication strategies to ensure a smooth flow of data through the processes. For example, critical elements such as geography or classifications may be developed and produced by other stakeholders in the census agency or Government. The census agency may be dependent on their timely production to meet its own internal schedule. Clearly defined objectives and sustained communication are essential to ensure that deadlines are met.

3.   Budget and cost recovery

6.71   The census agency should prepare a budget that reflects projected costs associated with plans for census products, including their development and dissemination. It is recommended that census offices include a census product plan and budget as part of the overall census budget. Having an adequate budget for this phase of the census process is essential for the census office so that it has enough financial and human resources to fulfil its obligations towards data users. These resources are needed not only to develop the products but also to be able to invest in appropriate technological tools and media for census data dissemination. It is important that the budget allocated for the execution of the plan be closely monitored and regularly evaluated to ensure that money has been spent effectively.

6.72   Each census agency and national Government determines their policy for the provision of results of their census. While there is a general trend towards providing census results free of charge, generally through the Internet, some census agencies charge a fee for their data or for specialized census products. In the latter case, some census agencies rely on the sale of census products to recover the costs associated with the collection and processing of census data.

6.73   However, when choosing a funding model for a census or a pricing model for digital data and products, census agencies should bear in mind that the United Nations Fundamental Principles of Official Statistics[84] and *Principles and Recommendations for Population and Housing Censuses, Revision 3*, recommend that most census data be made easily accessible to the public. In addition, the public and data users increasingly expect census agencies to release data products free of cost and in a useful format online through the agency's official Internet website. These expectations come from the fact that the public may expect free access to data as a condition of taxpayer support. In addition, local communities may expect free access to census data products as a condition of responding to the census and cooperating with the census agency.

6.74   A further distinction exists between pricing digital versus physical products. The selling of physical products may be considered acceptable in order to recover the cost of their production and shipping. However, as a public service, census agencies often plan in advance a certain number of physical copies of products for free distribution to elected officials, senior government managers, local communities, non-governmental organizations, libraries

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[84] General Assembly resolution 68/261, adopted on 29 January 2014.

and schools. Census agencies commonly use a hybrid approach, whereby the product is sold in physical format but provided for free digitally from the agency's website.

6.75   Also, some data users will need specialized products that the census agency is not planning to produce as part of the general census programme. Therefore, a further distinction should be made between providing standard data products suitable for the vast majority of users and providing customized data products. The census agency, therefore, should establish a service to meet such specialized requests, for which a fee may be charged. When pricing for products and services is introduced, policies need to be developed regarding who is to be charged and how prices are to be calculated.

4.   Quality assurance and risk management

6.76   The goal of every census agency should be to present products of high quality. Risk is also ever present throughout the entire census process, including during the development of product phase. This section will identify a number of strategies for managers to maintain quality and reduce the likelihood of risks occurring.

4.1   Quality assurance

6.77   The census agency, and its management, is ultimately responsible for the quality of census data. According to the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paragraph 3.242, quality refers primarily to user needs and satisfaction. It is recognized that even if data are accurate, they do not have sufficient quality if they are produced too late to be useful, or cannot be easily accessed, or conflict with other credible data, or are too costly to produce. Therefore, quality is increasingly approached as a multidimensional concept. It has been suggested that the output of any statistical exercise should possess the following attributes: accuracy, relevance, reliability, timeliness, punctuality, accessibility, clarity, coherence, comparability and metadata.[85]

6.78   Management of quality in census dissemination is driven by concerns about delivering relevant products and services while maintaining accuracy of the data and ensuring the timeliness and predictability of data release within agreed budgetary limits.

6.79   Managers must assume responsibility for quality assurance of census data and products. It is essential that the data from a census and products that include such data be of the highest possible quality and accuracy. Consequently, one of the first steps in the management of the dissemination phase of a census is development of a quality assurance strategy.

6.80   While developing products, census managers are encouraged to use a product validation and review system. This system should be promoted as a tool for improving

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[85] *Guidelines for the Template for a Generic National Quality Assurance Framework (NQAF)*, United Nations Statistics Division, New York, 2012, available at http://unstats.un.org/unsd/dnss/docs-nqaf/GUIDELINES%208%20Feb%202012.pdf.

product quality and protecting the reputation of the census agency and not as a tool for blaming staff for making errors. Before release, every product should be thoroughly reviewed by independent subject matter experts as well as managers who oversaw development of the product.

4.2   Managing risk

6.81   Managing risks improves the likelihood of project success. When planning census products, managers are encouraged to identify the risks associated with the development and release of the product, assess the likelihood of those risks occurring, estimate their impact on the project, and plan responses to risks deemed to be of sufficiently high likelihood and of sufficiently severe impact. By taking these steps, managers help to plan for contingencies and potentially save time and money later.

6.82   Risk is present in every project and at every step. There are many tools for identifying risks, but one of the most useful is an analysis of strengths, weaknesses, opportunities and threats (SWOT). Such an analysis during the product phase is based on information gained from the user consultation process, market research results and experience. By analysing these four components, managers can more effectively plan the census products development phase and prepare risk mitigation strategies (table 28).

Table 28

Schematic of strengths, weaknesses, opportunities and threats

	Existing	**Potential**
Positive	*Strengths* Knowledge, skills, or abilities of the census agency that distinguish the organization from others Example: exclusive access to record-level census results	*Opportunities* Areas in which the census agency could engage to the benefit of the mission Example: applying new technology to save resources And increase efficiency
Negative	*Weaknesses* Aspects of the census agency that currently prevent or hamper the success of the mission Example: poorly trained staff	*Threats* Areas that the census agency should avoid or mitigate to prevent jeopardizing the mission Example: establishing a "plan B" far in advance if a product should fall behind schedule or lose resources

6.83   These four components can be categorized in several schemes. For example, strengths and opportunities can bring about *positive* outcomes, while weaknesses and threats can lead to *negative* outcomes. Furthermore, strengths and weaknesses *exist* at present while opportunities and threats can *potentially* occur.

6.84   A further distinction in this form of risk assessment is between internal and external events. For example, threats to the completion of the product phase may exist internally (such as key staff departing) or externally (such as ministerial-level budget cuts). Managers conducting SWOT analysis should consider all of these dimensions.

6.85   When conducting a risk assessment, managers should identify mitigation strategies for each risk. For example, strengths and opportunities should be enhanced or exploited to maximize their benefit, while weaknesses and threats should be avoided or corrected to minimize their impact on the success of the mission.

4.3   Monitoring, evaluating, and change control

6.86   The effectiveness of the census product phase must be objectively evaluated. The analysis of the information should be used to adjust the programme as required. Key areas to be monitored depend on the specific project or activity, but could include:

(a) **User consultation:** types of products requested and ability to deliver; feedback from users throughout product phase.

(b) **Product development:** comparison of planned budget and schedule to actual; assessment of statistical quality before product release.

(c) **Product dissemination:** website analytics; response rate to promotional activities; number of technical assistance enquiries; feedback from census data users.

6.87   These evaluations should take place regularly, for example on a monthly or quarterly basis, again depending on the specific activity. The use of regularly scheduled evaluations provides an opportunity to revise tactics to ensure that the objectives of the product phase will be met. Measuring objectives against actual results identifies where variances have occurred; managers can then take corrective action to bring projected and actual results in line.

6.88   Monitoring and evaluation can reveal when activities are not working as intended or have to change. Change is inevitably disruptive and involves risk (either positive or negative). Therefore, when changes are requested by staff or other stakeholders, a process for ensuring a smooth transition should be in place well in advance of implementation. These processes encompass a principle known as change control, with the primary objectives of determining if change needs to occur, coordinating such change, and reducing the risk of change negatively affecting the project scope, schedule or budget.

5.   Managing resources

6.89   Resources are defined as all of the items necessary to accomplish a task or project. For the census product phase, the most important considerations are staffing requirements, skills and training, equipment, and infrastructure.

5.1   Staff requirements and skills

6.90   Census products require a variety of skills. In addition to the traditional skills expected of a census agency, such as statistics, demography and cartography, the product phase may need staff trained in such areas as website design, graphic design, computer programming, public relations, GIS, database and server technology, and other IT infrastructure. These needs will vary from agency to agency and may be kept in-house or contracted from private vendors. Many of these skills are transferrable from the field operations and data-processing stages.

6.91   Staff can acquire some of these skills relatively quickly through training, but others may require years of experience. For instance, designing a basic website may require only a few days of training (assuming existing familiarity with computers). However, to design an advanced interactive web application for viewing or downloading data may require years of specialized knowledge in the areas mentioned above. Managers should carefully articulate their needs when hiring or reassigning staff to ensure that adequate skills are being acquired.

6.92   In general, the production team should be trained in the production, tabulation and output platforms, with clearly defined objectives and deliverables. Procedures should be discussed, clarified, and documented, and team members should be encouraged to suggest improvements. In the event that training is required, staff can obtain such training through workshops locally, regionally or internationally. Online learning is a cost-effective option for introductory materials, but staff may benefit more from in-person training, as it can be more interactive. Managers should closely monitor the amount of time each staff member has spent training in order to avoid overcommitment.

6.93   Sometimes, certain sets of skills cannot be filled by directly hired agency staff, for reasons including limited staff expertise or short duration of a project. In such instances, managers may decide to contract it out. For this they need to conduct a process of seeking expressions of interest from external vendors. As with acquiring staff of the appropriate skill level, contracts to private vendors should clearly specify the expectations of the census agency. Requirements, deliverables and deadlines should be explicitly identified.

5.2   Equipment and infrastructure

6.94   Equipment and infrastructure are essential elements for the successful completion of the census product phase. Beyond the usual requirements such as facilities, computers and furniture, creating and disseminating products may require specialized equipment beyond the current capacity of the census agency, especially for IT and printing.

6.95   IT requirements of the dissemination phase can be considerable, depending on the user requirements and budget available for census products. Users are increasingly expecting interactive Internet applications for retrieving data and producing visualizations. These applications can range from simple to complex, with potentially extensive hardware requirements (including servers and telecommunications equipment). Hardware can be housed on site or externally. Managers may wish to host certain dissemination products, such

as their public-facing website, externally or using a cloud-based solution (that is, a server run by an outside organization) if the census agency's facilities do not have reliable Internet or electrical connectivity. Managers are advised to consult with their specialized IT staff and external consultants before making major IT decisions.

6.96   For physical census products, such as books, pamphlets and CD-ROMs, the census agency may be able to print these items itself if the equipment is already in place or if the volume will be relatively low. However, managers should bear in mind the costs of purchasing and maintaining printing equipment. Therefore, it may be preferable to outsource these requirements to a publishing firm. Many census agencies keep the design and layout components of census products in-house, with the expectation that the publishing firm will simply print and ship the materials. In that arrangement, the census agency's design staff should work closely with managers when developing the requirements for the tendering process to ensure a seamless delivery of digital design files to the publishing firm and a final product that appears as designed.

6.97   As with staff, certain equipment requirements may be furnished by a contracted firm. This arrangement may prove more cost-effective than purchasing all of the necessary equipment and training staff in its use. However, managers should work closely with any private sector census product partners to ensure their equipment is secure and reliable. These terms should be clearly laid out during the tendering process. If not, the consequences for the census agency could be severe. For example, if a private firm is provided with sensitive census data (such as individual records) not yet approved for public release, the census agency is placing a great deal of trust in that firm's ability to secure the data. If a data loss were to occur at the firm, the census agency may receive most of the blame.

6.   Product policy considerations

6.98   When planning products, census managers should take into account applicable national laws and regulations related to copyright for use of the data as well as intellectual property rights provisions. Furthermore, census managers should apprise themselves of the latest developments in open data practices and transparency. These topics are of particular importance nationally and internationally and can demonstrate that the census agency is a modern, responsive, accountable and reliable organization.

6.1   Open data and transparency

6.99   Accessibility is a quality attribute of census outputs. A strategic objective of the census includes implementing policies designed to safeguard the access of all users to census results. An increasing trend in enhancing accessibility to census data is adoption of open data policies, whereby data are generally released without restrictions on reuse, modification or commercial use. With this arrangement, non-burdensome restrictions on data may be allowed, such as requiring attribution of the original data source (for example, the census agency).

6.100   Both developed and developing countries have begun adopting open data policies. In conjunction with these policies, national Governments are creating data catalogues and clearing houses for national statistics. For example, the Government of Kenya launched the Kenya Open Data initiative in 2011 to meet constitutional requirements for information access, and the 2009 census data were among the first data uploaded.[86] Census managers should ensure their data can easily be transmitted to a national data clearing house, if one exists. Managers should also verify if their country has established national standards for statistical and geospatial data to which the census agency is expected to adhere, such as a national spatial data infrastructure policy.

6.101   Besides national Governments, international donors are also adding funding contingencies that require aid recipients to publicly release data funded by donor money. Both governmental and non-governmental organizations have adopted these open data policies, including the United States Agency for International Development[87] and the Bill and Melinda Gates Foundation.[88] Census managers coordinating the receipt of donor funding should work with donors to clarify their open data policies before accepting such funding.

6.102   Census agencies may be required by government policy to release census data freely and without restriction to adhere to open data policies. For example, the United Kingdom began releasing government data under an open data licence in 2010.[89] However, if no such policy exists, the census agency should still weigh the value of census data as a public good against The burden on the agency to produce data when deciding how to license data.

6.2   *Management of intellectual property and copyright*

6.103   Census product development should comply with the standard intellectual property protection practices of the agency and Government. For internally developed products, the census agency should procure written assignment of intellectual property rights signed by the agency's employees who create the products. For externally developed products, ownership of intellectual property rights must be clearly defined in the contract so that the census agency retains such rights.

6.104   It is also important that the census agency have clear stipulations regarding its copyright laws to the data. Terms and conditions of use of the data should be clearly set out, including attribution when data are reused or redisseminated. Census managers should ensure that any data usage agreement to be signed by specialized customers is in accordance with the agency's policy on ownership and licensing of intellectual property. To avoid liability issues,

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[86] See the Kenya Open Data portal at www.opendata.go.ke.

[87] See http://blog.usaid.gov/2014/10/announcing-usaids-open-data-policy/.

[88] See the Bill and Melinda Gates Foundation open access policy at http://www.gatesfoundation.org/How-We-Work/General-Information/Open-Access-Policy.

[89] See the open government license for public sector information at http://www.nationalarchives.gov.uk/doc/open-government-licence.

managers should check that these policies do not conflict with any existing open data or transparency policies, as outlined in the previous section.

7.   Preparing the final product dissemination plan

6.105   Census product planning is both strategic and operational. Strategic planning focuses on long-range issues such as how the mix of products can vary in different stages in the life cycle of the product range. The operational plan is short range and results oriented, and should deal with facts rather than theory. There are likely to be a number of operational plans associated with a strategic plan, with a distinct operational plan for each key product. The following attributes should be considered in the development of census products.

(a) **Realistic.** Undue optimism can lead to unrealistic expectations by management. The acceptance and use of a census product plan occurs only when the scope and costs are realistic.

(b) **Comprehensive.** The ultimate success of the products depends on a detailed analysis of conditions within the user community and subsequently selecting appropriate strategies that best appeal to that community.

(c) **User friendly.** A product dissemination plan is a communication tool and, as such, it should be easy to read and understand, with the major points well defined. While other areas within the organization, or external consultants, may assist in the development of the plan, those who have the responsibility within the census agency for its implementation should write it.

(d) **Organizational commitment.** The dissemination plan is not for the exclusive use of a select division within the census agency. While management will have the final approval of a dissemination plan, the commitment of all stakeholders within the organization who use the plan will have an impact on the results.

(e) **Continuing review and improvement.** The product phase is dynamic, and regular monitoring and review of the plan is necessary to ensure its continued success. New opportunities and challenges can appear. Economic, political and competitive environments require different objectives and strategies. Revisions to the dissemination plan should reflect any changes in these environments.

6.106   The dissemination plan should cover the costs of the full range of dissemination activities. These include the costs associated with data validation, output systems development, and product development and production. Costs associated with marketing and continued support for all census products through the complete census cycle should also be included.

6.107   A management steering group can be established to review on a regular basis the development of the plan and to monitor progress under the plan.

6.108   For guidance, an example dissemination strategy for the United States 2010 census data product release plan is provided in annex VIII.

E. Product development

1. Introduction

6.109   All of the planning and user consultation until this point is to ensure a successful census product phase. When proceeding to product development, managers must remain aware of the plans laid previously and direct staff appropriately.

6.110   This section will discuss topics relevant to the development of individual census products. Topics will include good practices; considerations for data products versus publications and reports; and the selection of a dissemination medium.

2. Good practices

6.111   The following good practices are not exhaustive but cover some of the most important elements required for the successful development of census products. These practices cover concepts including business processes, audience awareness, protecting confidentiality, remaining neutral, considerations for data classification, and geographical place names. Managers are advised to formulate policy for each of these concepts in close consultation with their subject matter experts.

2.1 Individual product life cycle

6.112   Managers should establish a clearly defined individual product life cycle for their staff to follow. Having such a process in place will increase the quality of the products being released by the census agency and therefore improve the public's perception of the agency and increase the usefulness of the census.

6.113   The individual product life cycle was previously laid out in detail in section B, subsection 3.2, above. However, in summary, a recommended best practice is for individual products to follow the stages of (a) concept, (b) proposal, (c) development, (d) review, and (e) release. The conceptual and proposal stages ensure that problems are identified early in the process, while the review phase checks for errors and overall product quality just before release. While these stages may seem onerous, always bear in mind that the reputation of the census agency depends on the quality of its products.

2.2 Understanding the audience

6.114   Each product and service should be designed and developed with the end user in mind. Feedback from the user consultation process should be used to formulate each product in a manner that balances the preferences of most users with the needs of the census agency. This user preference is gleaned during the user consultation process.

6.115   Product development should not proceed before a comprehensive dissemination strategy is formulated incorporating the findings from market research and user consultation. Individual product strategies will provide the information necessary to determine funding requirements.

2.3   *Maintaining a neutral perspective*

6.116   It is important that national statistical and census offices maintain professionalism and demonstrate neutrality and objectivity in the presentation and interpretation of the results and be free from real or perceived political interference in order to ensure the objectivity and impartiality of the statistics. This in turn will build trust in and acceptance of the results. Furthermore, the disseminated census results should be of sufficient quality to meet user needs, and safeguards should be in place to ensure individual information is kept confidential.[90]

6.117   Census and statistical agencies are expected to maintain a non-political and unbiased perspective on the production and analysis of the nationally important data they produce. These data products and publications will be used by all levels of the nation's society to measure its people, places and economy, and therefore must be unquestionably reputable and beyond reproach. Managers should remind staff of their duty to accurately measure the nation's characteristics when developing products from census data and to not misrepresent the data.

2.4   *Protecting confidentiality*

6.118   Principle 6 of the Fundamental Principles of Official Statistics states: "Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes".[91] Maintaining data confidentiality is an indispensable element to maintaining the trust of respondents.[92] Consequently, individual-level census data must remain strictly confidential and data products must be reviewed to ensure that the privacy and personally identifiable information of respondents are preserved. Census managers, as the officials responsible for the conduct of the census, are often legally required and held accountable by their national Governments to protect census respondent data.

6.119   A technique for protecting confidentiality must be developed and applied to ensure not only that users receive high-quality data, but also that information provided by individuals cannot be identified from the data included in the output. To meet this requirement, various countries have adopted a wide range of procedures. The precise nature of such procedures should be determined by the census agency's subject matter experts, bearing in mind its circumstances, including stated objectives in relation to confidentiality.

6.120   A confidentiality algorithm – used to determine whether the information in a table can be released – can be included in these confidentiality procedures. Where applicable, the method of protecting confidentiality should be applied in the tabulation program itself (that is, the algorithm is built into the program). Tables that have not been subject to these

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[90]*Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.238.

[91] http://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx.

[92] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.285.

procedures should not be released to people or organizations outside the census agency. Regardless, all products should be reviewed for breaches of confidentiality prior to release.

6.121   In addition to protecting the confidentiality of respondents in data products, census managers must work closely with their IT departments to ensure their equipment is sufficiently secured against unauthorized access by either internal or external users. Internally, only staff with a "need to know" should have access directly to respondent data or data not approved for public release. Such data should be stored on restricted-access systems with individual user authentication (no shared logins). Managers should also ensure staff are using robust passwords, not sharing data with unauthorized individuals, and not accessing systems without permission. These systems should be developed after thorough evaluation and consultation with IT experts.

2.5   Structuring data

6.122   Census data users increasingly expect data to be released in a structured format. Structured data are formatted for easy ingestion into data analytics software, such as a spreadsheet application or database. Conversely, unstructured data cannot be easily ingested in such software. Structured data have the benefits of reducing the public burden for processing data and increasing the use of census data. Managers should be aware of data structuring requirements, if any, present in national open data and transparency initiatives and consult with their subject matter experts as needed. Managers should also consider establishing a standard data structure policy within the census agency.

6.123   An investigation into the data formats and media preferred by users should be included in the user consultation process. Output should be made available in non-proprietary industry standard data formats such as UTF-8 (text encoding) or CSV (tabular data storage). Because of the diversity of data formats and media available, it is most cost-effective to provide data in a manner to suit most users, but not all.

2.6   Classifying census data

6.124   A key attribute of the work of a census agency should be to produce output that presents the data according to standard classifications. A starting point for the consideration of these standards should be international classifications that have been issued by reputable and widely used standards organizations. Examples include the International Standard Classification of Occupations issued by the International Labour Organization, and the International Standard Classification of Education issued by the United Nations Educational, Scientific and Cultural Organization. The *Principles and Recommendations for Population and Housing Censuses, Revision 3*, also contain classifications for most of the population and housing characteristics on which information is collected.

6.125   Many of these standard classifications may have been used during the questionnaire development process. However, during the product phase, it may be necessary to edit or recode responses to match different classification schemes depending on the audience of the product (for example, national versus international). Recoding and editing during the product

phase should be conducted carefully, and managers should consult with their subject matter experts for guidance.

6.126   Within these guidelines, it must be understood that output information can never be more detailed than the information collected from respondents and transformed by coding in the processing phase. For example, some responses may not be coded to the most detailed level of a particular classification because the level of detail in the response is not sufficient. In these cases, a higher-level code in the classification (for example, at minor or major group) may be allocated.

6.127   In developing the output classifications, the census agency should cover the following steps:

   (a) Review of classifications to cover new topics and changes in concepts;

   (b) Development of a directory of classifications to enable effective access by users;

   (c) Development of a dictionary of census terms to assist users' understanding of the data items.

6.128   There are a number of issues relating to standard classifications that will affect the preparation of the data, and these should be clearly defined and understood by the dissemination project team prior to commencing production. These may include the following:

   (a) **New concepts and variables.** New topics that are collected in the census may result in additional classifications or new variables. Census concepts and classifications can change over time, often owing to the requirement to follow international or the agency's own standards.

   (b) **Modified classifications.** The need for different output categories is often highlighted by responses received from census tests and dress rehearsals. Questions that elicit obscure or widely varied answers may be restructured to avoid respondent confusion.

6.129   New and changed classifications will affect comparability with data from earlier censuses and will thus affect the production of any time series data. Where the changes to classifications are significant, concordances (also called crosswalks) should be developed to assist users to compare census data over time.

6.130   When staff are recoding or editing respondent data for the purposes of reclassification, managers must ensure processes are in place to review and monitor such activities. In seeking to fit data to an expected narrative, staff may edit or recode overzealously, leading to meaningless data products that could – at worst – misdirect national government resources. These problems should be identified early in the planning for products once the methodology is clearly articulated. However, the final product review should also check for serious methodological problems.

2.7 *Standardized place names and codes*

6.131   Census managers should require staff to adopt a standardized approach to place names and codes. These codes may be generated by a national government body, or such codes may not exist at all. Regardless, all census products should use standard place names and codes to allow for easy comparability by data users. This includes both geographical and tabular data products, since they will frequently need to be joined together by data users.

6.132   A typical approach is to classify places by both name and code. The place name should be standardized in the national language and perhaps translated to a common international language (such as English) if deemed beneficial for data users. The place code should be a unique identifier for every level of geography. A popular method is to classify each level of geography using a two- or three-digit code. For nested geography, such as a district within a province within a region, the individual codes are concatenated together to form a unique national code for that geographical unit.

3.   Data products

6.133   Data products include tabulations that are produced from the final census data, geographical data or microdata. Increasingly, census data products are released in digital format via the census agency's website in a structured, machine-readable format. Interactive web-based data tools provide a user-friendly entry point to the entire range of census data products, along with capabilities for querying, tabulating, graphing and mapping, thus facilitating the visualization, exploration and analysis of the data. Interactive web-based data tools enable the integration of statistical data with geographical data, which gives users the ability to build customized tables or spatially configure data outputs according to varying geographical requirements. In some countries, some data products are also released as hard-copy publications, but on a more limited scale. It is beneficial however, if most data products are developed with the goal of digital dissemination.

6.134   The production strategy for census data products should include the development and dissemination of metadata. It is important to provide a description of the aggregation and retrieval systems used to compile the basic tabulations and references to the use of these systems. The methodology for producing each data set should also be completely documented and provided to users as needed.

3.1 *Tabulated data*

6.135   Tabulated data are one of the primary products from a census and must respond to the needs of data users.[93] Standard tabulated products that satisfy the majority of census data users provide basic tabulations and cross-tabulations on subjects such as age and sex, labour force characteristics, and family composition. Other products for specialized users may require customized tabulations.

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[93] Ibid., para. 3.307.

6.136   Customized output is provided for users whose requirements are more specialized and cannot be satisfied by standard tabulations. These users provide the specifications for the tabulations they require, and the data output is produced on a consultancy basis. In order to meet the demand for customized output, it is useful to establish an "on request" service for users who require aggregates not available through other means.[94] The service would require that users provide the census office with the details of the tables or other aggregates requested so that the census office could fulfil the request, normally against payment of a certain fee. For more information on cost recovery, see section D.3 above. Offering and promoting this service, especially online, would place the statistical service in a more desirable proactive position, rather than a static one, and could be a strong catalyst for closer cooperation with census product users.

6.137   Production of tabulated data products generally follows this procedure:

(a) Development of prototypes based on results of user consultation. This may be an iterative (or dynamic) process, with further revisions applied as further consultation takes place. It is important that the outcome of each iteration be shared with all participants to ensure that all users are satisfied with the final outcome.

(b) Coding and production of prototype tables using test data. This will also serve as a test for the production and output systems.

(c) Finalizing tabulation content. It is important to set a definite date for this and to adhere firmly to this date.

(d) Live data production for standard output.

(e) Release of a consultancy service for customized tabulations (where appropriate).

(f) Specialized table production for specific products.

6.138   The final tabulations should be presented and explained in a way that will facilitate their extensive use. The data should be shown for appropriate geographical and administrative divisions and classified by important demographic variables. The products should also contain information on how the data were collected and processed, results of available evaluation studies, and appraisals of the substantive significance of the results presented. In addition, a sufficient number of maps should be provided to allow the identification of the geographical units for which the statistics are presented.

6.139   All tabulated data products should undergo a thorough internal quality review by subject matter experts prior to release, preferably experts not involved in the production of the product.

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[94] Ibid., para. 3.393.

3.2   Geographical data

6.140   Geographical data products are useful for a broad range of applications. A key attribute of census data is that they provide information relating to small areas (such as enumeration areas, or aggregations of small numbers of enumeration areas). In addition, census agencies may develop a number of ancillary data sets that are of use to the data user community or required by law.

6.141   To maximize the usefulness of their data, census agency managers should consider developing the geographical products presented in table 29.

Table 29

Geographical products

Data sets	Type	Description
Statistical boundaries	Areal, linear	Most census agencies should release statistical geography to correspond to tabular data. These data sets could include enumeration areas and higher-level aggregated areas. Larger agglomerations could include urban or metropolitan areas as well. A 1-kilometre geographical grid is also now regularly produced in a number of national censuses.
Political and administrative boundaries	Areal, linear	Census results will commonly be released to correspond to political geography. Therefore, the boundaries used at the time of the census for provinces, districts, election areas and similar units should be provided to the public.
Special regions	Areal, linear	Special regions could include any number of geographical delineations. These data sets will vary by country and the needs of Government, but could include national parks, military bases, ecological regions or tribal areas.
Environmental features	Areal, linear, point	Census agencies commonly use environmental features to delineate statistical geography. Depending on the ownership of these data, the census agency should consider releasing these ancillary data products for public good. These data sets could include rivers, water bodies or coastlines.
Transportation features	Linear, point	Transportation features such as roads, railroads and airports are also used to delineate statistical geography or identify landmarks for field staff. These data may provide a useful service if released.
Cities, towns and other landmarks	Point	The location of cities, towns, villages and other landmarks are commonly gathered by census agencies and could be useful to data users.

6.142   Maintaining geographical data quality requires several unique business processes. To ensure the highest level of quality, managers should consult with their geographical subject matter experts to develop a workflow for preventing the introduction of errors into geographical data. Topology – preserving coincidence between like features – is a key concern.

6.143   Using the boundary data from the previous census, a time series concordance data set can be developed to align enumeration areas from earlier censuses with the current census boundaries. Changes to enumeration area boundaries will have an impact on the comparability of data across censuses.

6.144   Beyond providing geographical data for bulk download, census agencies may be expected to develop advanced interfaces and tools for the data user community.

3.3   Microdata

6.145   In general, when statistical agencies or other data producers conduct surveys or censuses or collect administrative data, they gather information from each unit of observation.[95] Such a unit can be a household, a person, a firm or enterprise, an agricultural holding, a school, a health facility or other. In this context, microdata are the electronic data files containing the information about each unit of observation. Microdata are thus different from macrodata or aggregated data, which provide a summarized version of this information in the form of means, ratios, frequencies or other summary statistics. In the context of the population and housing census, microdata refer to electronic files consisting of individual records on persons, households and housing units.

6.146   Data users increasingly expect microdata products for advanced analytical use. Microdata provide individual responses and the associated characteristics of that respondent. The summary tables and tabular and narrative profile reports based on census data meet the needs of many data users, but some advanced users may want access to microdata to create or define their own tabulations and to be able to further draw on the richness of detail recorded in the census.

6.147   Providing access to microdata can be a way of extracting additional value from the cost of collecting official statistics, and of obtaining valuable insights into the quality of the data. Lack of access to microdata may result in researchers developing and conducting their own lower-quality statistical collections, adding to the reporting burden imposed on the community. Often only a small sample of such response-level data is provided, however, and specific locations are offset (anonymized) to protect confidentiality. Therefore, managers should be mindful of the sensitivities associated with producing and releasing microdata to avoid any potential confidentiality breaches while still presenting a useful data set for the user community.

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[95] Ibid., para. 3.373.

6.148   According to the Economic Commission for Europe (ECE), making microdata available does not contradict principle 6 of the United Nations Fundamental Principles of Official Statistics.[96] This principle deals with statistical confidentiality and states: "Individual data collected by statistical agencies for statistical compilation, whether or not they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes." ECE proposed the following principles for managing the confidentiality of microdata in line with principle 6:

(a) **Principle 1.** It is appropriate for microdata collected for official statistical purposes to be used for statistical analysis to support research as long as confidentiality is protected.

(b) **Principle 2.** Microdata should only be made available for statistical purposes.

(c) **Principle 3.** Provision of microdata should be consistent with legal and other necessary arrangements that ensure that confidentiality of the released microdata is protected.

(d) **Principle 4.** The procedures for researcher access to microdata, as well as the uses and users of microdata, should be transparent and publicly available.

6.149   The ECE microdata principles outline several solutions for providing access to census microdata along with useful case studies of their application by a variety of national statistical offices. These solutions vary in the methods they use to ensure the confidentiality of individual responses.

6.150   When disseminating census microdata files to the public, researchers or other agencies, the national statistical authority faces a conflicting mission. On the one hand, it aims to release microdata files supporting a wide range of statistical analyses; on the other, it must safeguard the confidentiality of respondents' identities. Processes aimed at the latter are referred to collectively as statistical disclosure control or anonymization.[97]

6.151   Anonymized microdata files ensure that identification of individuals is highly unlikely through the removal of names and addresses along with other confidentiality-preserving steps, including collapsing geographical details and techniques such as data swapping and data perturbation. Public use files are commonly used anonymized microdata files that are disseminated for general public use outside the national statistical office. The level of confidentiality protection in public use files should be such that identification is not possible even when matched with other data files. Licensed files are also anonymized but are distinct from public use files in that their use is restricted to approved researchers and an

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[96] *Managing Statistical Confidentiality and Microdata Access: Principles and Guidelines of Good Practice*, New York, Economic Commission for Europe, 2007, available at http://www.unece.org/fileadmin/DAM/stats/publications/Managing.statistical.confidentiality.and.microdata.access.pdf.

[97] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.384.

undertaking or contract is signed before files are provided to the researchers. Even if advertised as generally available to the public, they are not released before an undertaking or contract is provided by the researcher. Even though anonymized and other steps are taken to ensure that identification of individuals is highly unlikely when used in isolation, licensed files may contain potentially identifiable data if linked with other data files; this is one reason why a preventive undertaking or contract is required. There may be other conditions of use that the national statistical office may impose on researchers.

6.152   It is also possible to provide access to non-anonymized files. Remote access facilities allow researchers to produce statistical outputs from microdata files through computer networks, without the researchers actually "seeing" the microdata. Because of the additional controls that are available through remote access facilities, and the fact that microdata do not actually leave the national statistical office, access to more detailed microdata can be provided in this way. Another way to provide access to non-anonymized files is through arrangements for allowing researchers to work in a controlled environment on the premises of the national statistical office. Data laboratories on the premises of the national statistical offices provide on-site access to more identifiable microdata and to larger sample sizes than typically available through public use files, usually with stringent audit trails and under national statistical office supervision. The access to more detailed data creates some inconvenience to the researcher because of the requirement of working at the national statistical office, or at a national statistical office enclave.

6.153   When considering the creation of microdata products, census managers are often concerned primarily with maintaining confidentiality in accordance with these principles. It is also important to consider whether the census agency possesses sufficient authority (such as a legal mandate) to support access to microdata. In the budgetary context, census managers should estimate the cost of implementing a microdata dissemination programme, including the cost of creating and documenting microdata files, creating access tools and safeguards, training needs, and supporting and authorizing enquiries made by the user community.

4.   Publications and reports

6.154   Data products are only one component of the dissemination programme of a census agency. In addition to the standard release of raw tabular data, geographical data and microdata, census agencies are often expected to provide in-depth analysis of the characteristics of the data, the geographical patterns present, and documentation of the methodology used in the production of data.

6.155   As stated previously, census agencies have a duty to present the data neutrally. When developing publications, staff may be tempted to draw their own conclusions for patterns in the data on the basis of political leanings. Managers should pay close attention to the language used by staff in publications to ensure they do not inaccurately represent the data. In developing publications, managers may want to review the "Making Data Meaningful"

guides produced by ECE,[98] which seek "to help managers, statisticians and media relations officers in statistical organizations use text and visualizations to bring statistics to life for non-statisticians; find the best way to get their message across or define strategies for improving statistical literacy".

6.156   Box 32 presents product preparation considerations for a published report. The ensuing text provides further details on issues that require consideration in the light of each country's circumstances.

Box 32. Product preparation considerations for a published report

Issues requiring consideration when preparing a report for publication include the following.

- Landscape or portrait orientation, which depends on individual table requirements, for example:

  o   A cross-classification with a relatively small number of columns may well fit in a portrait format, whereas a larger number of columns may require a landscape orientation.

  o   There are well-recognized perceptual difficulties in linking the data in more distant columns back to the stubs describing those data.

  o   If there are many rows in a table, the need for more frequent repetition of the table stubs may add considerably to the number of pages in (and, thus, cost of) a publication.

- Explanatory notes should be provided in all releases of information to ensure that users of the census data are aware of the following:

  o   Important contextual information such as details about the collection of the information;

  o   The scope and coverage of the collection;

  o   Interpretation of technical terms used in the publication and any limitations affecting the accuracy of the data.

- Further assistance to users of the data will be provided by presentation of a detailed table of contents and, where the product is large, an index. The extent of these elements of the product will be influenced by both the production facilities available to the census agency and the resources devoted to the individual product.

- To give an authoritative and professional look and feel to the products, a professional cover page should be designed. This will assist in creating a link to the authority of the census agency (see also section F, subsection 2.3, below).

4.1   Analytical products

6.157   Analytical products of the census agency encompass a variety of possible outputs. Traditionally, these products have been analytical reports and briefs that examine the patterns and characteristics of the census data in long-form writing. These reports remain valuable for

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[98] Available at http://www.unece.org/stats/documents/writing.

the user community to help to focus their attention on critical issues and national priorities. Analytical reports must be based on user needs and respond to a country's specific development needs and emerging issues. These reports can also be used to show time series and trend analyses of socioeconomic and demographic indicators and may combine census data with other data sources to provide a more comprehensive and current outlook.[99]

6.158   Census agencies are also embracing technology for analysis and presentation of data. Developing enhanced visualizations of census data – which may be static or interactive – has grown more popular with advances in Internet technology. In addition, desktop software applications, including standard office spreadsheet software, now provide the ability to generate visualizations of data beyond the standard histograms, line graphs and maps commonly produced using census data. Managers should encourage their staff to explore creative methods for visualizing data for both internal use (for example, exploring anomalies within the data) and external publications.

6.159   Regardless of the tools and methods used for analysing census data, analytical products should remain focused around the key themes identified by the census agency. These themes may be recommended internationally, such as maternal deaths and disability, or determined to be a national priority by the Government. Managers should remain aware of the intended message when providing direction for analytical products and reviewing them before release.

4.2   Cartographic products

6.160   Census offices should take advantage of emerging GIS technology to make the census results more understandable and easier to use. The purpose of statistical maps is to present the results in terms of their geographical distribution and also to make it easier for the general public to understand census results than when information is presented only in the form of statistical tables.[100]

6.161   Census agencies are uniquely positioned to present thematic cartographic products, such as atlases, static maps and interactive web maps, as a valuable service to users. These products are often in high demand from the user community and policymakers since they provide the opportunity to examine spatial patterns of the results and, therefore, identify areas for Government to prioritize resources.

6.162   Most static cartographic products, such as atlases and stand-alone maps, can be created using popular GIS and graphics design software. More complicated tools, such as interactive web mapping applications, require additional skills and resources that may not be present in the census agency. In that case, the manager should consider the staff capabilities when requesting products and exploring additional training or contracting out where appropriate.

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[99] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.321.

[100] Ibid., para. 3.349.

6.163   More information concerning development requirements is provided in table 30 for specific types of cartographic products.

Table 30

Cartographic products and their requirements

Product type	Software or skills required	Description
Static map (print and web)	GIS	Static maps are generally easy to produce with off-the-shelf GIS software and limited training. Producing maps of professional quality, however, requires more advanced skills.
Census atlas (print and web)	GIS, graphic design	A census atlas is a major undertaking, usually requiring a team of staff with subject matter expertise, geographical expertise and graphic design ability.
Interactive map (web)	GIS, graphic design, website design, computer programming	Cartographic products that are web-based and offer the ability for users to interact with the data visually are increasingly in demand. However, as the skills column shows, these products can be difficult to produce unless staff possess or can acquire the abilities needed.

6.164   Cartographic products can also introduce sensitivities and should be managed carefully. As a consequence of a phenomenon known as the modifiable areal unit problem, geographical boundaries and indicators within those boundaries can be manipulated to either mask or accentuate patterns on the basis of the message the cartographer wishes to portray. Managers must task their cartographers to use the appropriate methodology and boundary data sets when producing maps in order to avoid misleading their audience.

6.165   Certain indicators, when mapped, may also show patterns that are contrary to generally accepted wisdom, leading to negative reactions from leaders at the local or national levels. As stated previously, managers are reminded to make every effort to remain neutral and avoid political interference when developing census products. If mapped correctly, census data should inform policymakers of the reality and provide sound guidance for national policies.

4.3   Technical and methodological documentation

6.166   All data products, and many publications, should include a detailed discussion of the methodology that led to their creation. Methodological reports may include the census methodology, encompassing, if applicable, sampling design and methodology and a census evaluation report, which may include estimates of census coverage and the methodology used

for their preparation.[101] These documents demonstrate to the data user community – and the public in general – the willingness of the census agency to be open and transparent. Furthermore, the preparation of methodological documents compels staff to articulate the procedures used to create their products.

6.167   Technical and methodological documentation generally includes:

   (a) A detailed explanation of the process used to prepare the product;

   (b) Formulae and algorithms key to the development of the product;

   (c) Decisions and assumptions made during the planning of the product;

   (d) Technical definitions and explanations for terms used, including international or professional standards applied;

   (e) Ancillary data products, if necessary;

   (f) Contact information for further enquiry.

6.168   These procedures are invaluable in the future for recreating products for other census and survey operations. Staff should also preserve all of the key original files and data sets used in the creation of products likely to be reproduced for future operations.

6.169   Metadata – or "data about data" – are also necessary. In order to assist data users to better understand and interpret the data, it is important that there be adequate documentation providing a complete and clear description of the production process, including data sources, concepts, definitions and methods used. This information represents metadata that, it is recommended, should accompany all census products. Metadata will promote transparency and credibility of census results. Also, dissemination of census products with accompanying metadata ensures harmonization and comparability of census data with other data sets.[102]

6.170   Metadata should accompany individual data products and contain all of the fundamental attributes of the data product to aid the end user. Metadata follow international standards, such as ISO 19115 for geographical metadata, and are typically structured using extensible markup language (XML). Since data products are frequently redistributed outside the census agency's control, metadata are critical for maintaining source and provenance information of the data products.

5.   Dissemination media

6.171   A census is not complete until the information collected is made available to potential users in a format suited to their needs. Consequently, meeting the needs of data users means that the data producer should not only provide data products to the users, but should also provide them in formats that are suitable to the needs of the users. The information in the products may be included in published tables and reports for general distribution, produced as

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[101] Ibid., para. 3.322.

[102] Ibid., para. 3.290.

tables in unpublished form for limited distribution or stored in a database and supplied upon request, or disseminated online either as static or interactive products.[103]

6.172   It should be noted, however, that regardless of mode, all dissemination is subject to issues of quality assurance, possible disclosure of information about identifiable respondents, and copyright and ownership. In addition, the issue of cost recovery has become important to many statistical organizations. Each medium of dissemination has its advantages and limitations, and the choice of one or more of them depends on the context, and on the intended categories of users. In most instances, these methods complement each other and can provide effective ways to reach out to the public and private sectors.

6.173   When data are provided in electronic form, special attention should be given to providing users with easy means of data retrieval. The options for obtaining the relevant meta-information and the data should be accessible in standard and contemporary formats.

6.174   Managers should carefully consider the medium chosen for dissemination of census products. Ideally, these decisions are made early in the planning process for a census product, even before product development has begun. Choosing the medium early is important because it is dependent on the type of census product. The dissemination medium should not be chosen after the product has already been developed.

6.175   The most appropriate methods of dissemination are those that directly meet the needs of the data product users. A distribution process should be established to deliver products and services in the most useful, timely and cost-effective manner. It should also offer users alternative methods of delivery, including download via the Internet or possibly physical shipment.

5.1   *Choosing the medium*

6.176   How information is presented will have a considerable impact on how material will be interpreted (or misinterpreted). The points below are suggested as matters for consideration in setting more detailed objectives for census products.

6.177   Census tables and analytical reports can be printed or published digitally through the census agency website. The primary concern for that situation is planning for printing costs, since the formatting and layout will usually be the same for both printed and digitally published reports.

6.178   However, certain products are not appropriate for print, while others are not appropriate for the Internet. For example, an interactive web mapping application will not suitably transfer to a printed map. Conversely, a printed map may not transition well to the web if the map was designed to be printed on very large paper; the icons could be too small for website visitors to find useful. Therefore, each product must be designed with the dissemination medium in mind.

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[103] Ibid., para. 3.267.

6.179   In many countries, some users of census results will not have access to computers and will prefer output to be delivered through printed materials. Even in the most advanced countries, many users (for example, community organizations and individuals interested in the population profile of their local area) may wish to receive information in this format. Equally, in countries with relatively low use of computers or poor Internet connectivity, some agencies may prefer to receive information in a computer-readable form via CD-ROM or similar physical medium.

6.180   The challenge for the census agency is to develop products and systems that allow flexibility in output media. For example, it is possible to develop a standard set of commonly requested tables for each enumeration area and store these on the census agency's Internet website. Simple applications can be developed that allow the user to specify the enumeration area, combination of enumeration areas, or other specified statistical or political areas that are of interest. The census agency can then deliver the tables for the requested areas by direct download. However, the agency must bear in mind IT hardware and software costs for such a digital delivery system.

5.2   Software development

6.181   Software products are delivered via the Internet or installed directly on a user's operating system. The Internet is now prevalent in many parts of the world, following a growth in desktop and laptop computer use. Since the mid-2000s, rapid growth in mobile technology has greatly expanded the number of devices connecting to websites. Most census agencies now develop software dissemination platforms focused exclusively on the Internet. However, owing to poor Internet connectivity or customer needs, the development of disconnected applications installed directly on the user's operating system may be beneficial. Each agency will need to assess the needs and expectations of the user community to determine where to direct software development resources.

6.182   Software development requires a highly advanced and specialized skill set. These skills may not be present in the census agency. Furthermore, salary requirements for a permanent software developer may be beyond the resources of the census agency. Therefore, managers must consider whether developers of software products are hired internally or contracted from external vendors.

6.183   Different approaches to software development will need to be taken for traditional computers (such as desktops and laptops) and mobile devices (such as smartphones and tablets), since they use different operating systems and have distinct interfaces (mouse and keyboard versus touch screen). A further distinction can be made between applications that are native (the user installs directly) or web based (the application loads in a web browser). The web-based products section below discusses the latter in more detail. Managers should consult with their software developers and users to determine which platforms are most feasible for developing agency software.

6.184   The key functionality and design of the software should be determined after an extended period of internal and user consultation. However, managers must also exercise discipline over the potential for "scope creep" – the uncontrolled addition of features to the software product. The usefulness of the software diminishes as it loses focus, and the number of features should be controlled with respect to the ultimate purpose of the software. Otherwise, the product will not be successful.

6.185   Developing software products may require the acquisition of additional hardware (such as servers, premium computers and testing equipment) along with existing software for use as a development platform. Again, managers should consult with their software developers and external vendors to identify the best solution to meet the mission objectives and stay within scope, on schedule, and within the budget.

6.186   Depending on the complexity of the census software, user training may be necessary to ensure its correct use and widespread adoption.

5.3   Web-based interactive tools

6.187   Advanced interactive web products are growing in popularity. Interactive products allow for complex maps and visualizations, impromptu cross-tabulations, and other customized data queries. These products are designed using a combination of scripting languages that can be broadly divided into two groups depending on where they are executed: server side (on the agency server), and client side (on the user's computer or smartphone). This distinction is important for managers since these tools require computational resources to execute, and therefore affect hardware purchasing decisions. Common examples of languages capable of server- and client-side interaction include PHP, ASP and JavaScript.

6.188   Often, interactive products are designed to work in a desktop or laptop computing environment. However, a growing percentage of users are accessing census products via mobile technology such as smartphones and tablets. Some software used for desktop computers is not compatible with most mobile devices. Therefore, if a product is designed solely for use on a desktop computer, a potentially large segment of the user community is excluded from viewing the product.

6.189   Data storage is another key consideration. For structured data products from censuses, the ideal storage platform is a database. Databases are designed to store and retrieve data efficiently and quickly using a structured query language (SQL). Interactive web products query the database directly when retrieving results.

6.190   Some census agencies are now delivering data directly from their database to users through an application programming interface (API). Such interfaces have the benefit of providing public access to census data for application developers outside the agency.[104]

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[104] See, for example, the United States Census Bureau's application programming interface at http://www.census.gov/developers/.

6.191   With these principles in mind, managers should consult their developers to confirm if their current hardware and software configuration is sufficient to host web applications for census products. In addition, as always, managers are advised to listen to their user community to ascertain if any of these Internet products are useful for their purposes and suitable for the country.

5.4   *Accessibility and internationalization*

6.192   Managers should note that their Governments may have policies requiring official websites and software products to meet accessibility and internationalization standards. Internet standards for accessibility and internationalization are set forth by standardization bodies, such as the World Wide Web Consortium (W3C). Managers should also consult the ISO website.[105]

6.193   Accessibility involves designing products to improve their ease of use by persons with disabilities.[106] Removing design barriers for interacting with products can increase their use and greatly improve their functionality for persons with disabilities. Internationalization refers to design that takes into account different cultures, languages, and regions of the world.[107] Since each country is quite diverse, internationalization standards can also benefit the census data user community nationally as well as internationally. While both accessibility and internationalization have specific purposes, their full implementation results in more useful and compatible products that should see greater use.

5.5   *Printed materials*

6.194   Although more and more countries use software for online dissemination of their census results, printed publications remain an often-selected choice for the dissemination of the main census results. At least for the present, they reach out to the largest number of potential census data users.[108] Paper media do not require that the user has any particular equipment, software or technical skills. This fact applies especially to countries where Internet and electricity availability are low or distributed unevenly (urban versus rural, for example). The portability of print media is also a major advantage. However, print media require special considerations that may not apply to Internet media.

6.195   It is important that plans be made and sufficient funds be allocated to ensure publication of the tabulations of widespread interest. The choice of how the actual printing is to be done entails a trade-off involving quality, cost and speed. The best results can usually be obtained by sending the documents in computer-readable format to a professional printing plant. This will allow high-quality typesetting and the use of supporting colours.

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[105] See http://www.iso.org/iso/accessibility.

[106] See W3C, Accessibility, at https://www.w3.org/standards/webdesign/accessibility.

[107] See W3C, Internationalization, at https://www.w3.org/standards/webdesign/i18n.

[108] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.270.

Alternatively, master printouts can be made in the census office and sent to the printer for cheaper duplication or offset printing. There are also affordable high-speed printing systems that can be directly controlled by the computers in the census office.

6.196   Target dates for publication should be determined well in advance and processing and reproduction programmes should be planned accordingly. In addition to traditional methods of printing, there are various methods of reproduction available that are rapid, economical and legible, and these should be investigated.

5.6   CD-ROM, portable flash drives, and similar portable media

6.197   For an increasing number of users, computer-readable magnetic and optical media are the preferred medium of dissemination. This is because data in this form are often less expensive to obtain, copy and store. In addition, they are directly available for further computer processing and analysis.[109]

6.198   Technology such as CD-ROM and DVD-ROM discs provides a medium of distribution for large data sets that are not subject to frequent change or updating. Standard discs are read-only optical media. They have a very large storage capacity, are durable, and can be produced inexpensively. Because the results of a census are supposed to be final, dissemination on a read-only medium should be satisfactory.

6.199   Widespread dissemination of census statistics using flash drives or memory sticks may be recommended for very large volumes of digital content that cannot reasonably be disseminated over the Internet. Further development of media for storing digital content will inevitably have an impact on the dissemination of census results. It is thus necessary to keep abreast with this development in order to meet the changing needs of users of census statistics.

F.   Product dissemination and promotion for utilization

1.   Introduction

6.200   Once the product has been finalized by the census agency, a process commences for the release of that product to the customer or the public. This process should first be planned and strategized through development of a promotional strategy. With the strategy in place, the next stage is launching the product and providing the necessary level of support. Finally, once a product has been released, the closeout activity should be initiated for an orderly conclusion of the product phase.

2.   Promotional strategy for utilization of results

6.201   The aim of the promotional strategy should be to position the census agency and its products and services as the primary source of quality demographic and socioeconomic

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[109] Ibid., para. 3.275.

information on the population. The promotional strategy expands on the broad direction outlined in the census dissemination strategy and should be aligned with the communication and publicity strategy. The recommendations in the promotional strategy are based on information from historical research, evaluation and experience of earlier census output programmes, user consultation, and market research. Major considerations include preparation of the strategy, promotional activities and products, branding, and release coordination.

2.1   *Preparing the strategy*

6.202   A major objective of the strategy can be to increase the use of census data in the user community. Approaches to achieve this objective may include the following:

(a) Maintain the relationship with the existing user community;

(b) Develop new census products and services to meet emerging needs in the user community;

(c) Educate potential users about the census product and service range and possible benefits and applications of census data in research, planning and decision-making;

(d) Make the data widely accessible to the user community through the Internet, local governments or special interest groups.

6.203   A key portion of the strategy is identifying a promotional message. A generic promotional message could focus on the benefits of using census products and services and how different needs for demographic and socioeconomic data on the population can be satisfied by the agency. The message can focus on the fact that the information is readily available in the form suited to specific requirements. This can be detailed or summarized information, with extensive choice of geographical coverage and media delivery options. Specific promotional messages can be developed for individual campaigns of key products and services.

6.204   A public relations unit or marketing department is generally established to implement the promotional strategy and achieve a high positive profile for the census agency in the media and the community. This unit can assist with improving public awareness and understanding of statistics, and enhancing and coordinating the agency's corporate image. The public relations unit generates product media releases, monitors and manages media enquiries, liaises with journalists and other media personnel, and undertakes promotional launches and public awareness campaigns. Contracted marketing specialists or firms may also be used.

6.205   In addition to undertaking market research and providing feedback for the product development team, the public relations unit should report on the progress of individual promotional activities, evaluate the effectiveness of these activities, and adjust the promotional strategy as required.

2.2   *Promotional activities and products*

6.206   Promotional activities should implement the promotional strategy laid out previously. Such activities may include the following.

(a) **Website.** The census agency's official website should provide extensive information on census products and services, their applications and benefits, and the latest news.

(b) **Newsletter or blog.** A newsletter provides a means of communicating with users and, through response to various articles and questionnaires, gaining a better understanding of their needs. An added benefit is that the subscriber list can be built upon and become a depository of useful user information. The list can be segmented and used to tailor approaches.

(c) **Social media.** Major social media platforms should be used by the census agency to promote data releases. Data stories, infographics and compelling visualizations can also raise public interest in the usefulness of census data.

(d) **Mobile phone applications.** The census agency might provide free mobile phone applications to make available a census "pop quiz" to test knowledge of communities and to make census data available anywhere, any time and in any place.

(e) **Advertising campaigns.** These are appropriate for general awareness-raising and product-specific promotions aimed at target groups.

(f) **Trade shows, conferences and seminars.** Suitable venues can be selected that can be used to distribute census promotional materials, demonstrate the census product range, and outline possible applications and benefits of census data to specific user groups.

(g) **Press releases.** These can introduce census products to the broad community, for example through media liaison and official census product launches.

(h) **Articles.** Designed for the general public and shorter and less detailed than analytical reports, articles can help to focus the attention of the public on the importance of census data for addressing critical issues and national priorities.

(i) **Personal contact.** Visits to major data users or sponsors by census agency staff lead to a better understanding of specific user needs, offer an opportunity to demonstrate product options, and allow the agency to provide recommendations on best solutions.

(j) **Census in school programmes.** Information kits and lesson materials could provide educators with resources to teach students to know their communities and think about community needs through use of census information. For university-level students, workstations could be established to promote the use of census data for research purposes.

6.207   Box 33 provides an example from the 2011 census in India of raising awareness among various groups of the availability and use of census data.

Box 33. Raising awareness among various groups of the availability and use of census data: 2011 census in India

In India, a proactive strategy has been adopted to raise the awareness of various target groups about the availability of census data. The target groups include school students, university students, research scholars, government departments, the media and non-governmental organizations.

Every year about 50 to 100 workshops are held showcasing the release of census cross-classified tables and the highlights that emanate from the latest census data. Representatives from the target groups are invited to attend. Paper-writing competitions are held at universities to popularize the use of census data.

The Census in School programme is aimed at raising the awareness of school students through school kits containing literature, quiz cards, films on the census, and local maps. For the 2011 census, about 100,000 school kits were sent to schools for that purpose. The first school kit highlighted the importance of the census and announced the time and duration of the operation. School principals were requested to mention different aspects of census taking in their addresses at morning assemblies. A census week was observed just before the commencement of census operations. All these measures helped to generate awareness of the exercise, and the free publicity by students had a snowball effect.

Another major initiative to popularize census data involves setting up workstations for research on sample census microdata in universities and research institutes across the country. Initially the Government extended funding support to set up such workstations, whereby a computer laboratory is set up to access the microdata for individual research supervised by the faculty. All census tables published in the 1991, 2001 and 2011 censuses have been made available. In addition, a large collection of digital version of old census reports published since 1872 have also been made available. Universities and Institutes interested in setting up such workstations using their own funds are provided with the same set of data and reports.

Without the proactive strategy to popularize the use of census data, the huge public financial commitment in conducting the census would not be commensurate with the benefits.

Source: Office of the Registrar-General and Census Commissioner.

6.208   All of these activities should be integrated into the overall promotional strategy and coordinated by the census agency to ensure a consistent promotional message.

6.209   Accompanying the promotional activities are promotional products and materials. These materials can include brochures, posters, demonstration media, mobile phone applications, compelling data visualizations and infographics, school kits, and case study examples. Promotional material, as well as the products themselves, should be designed for easy brand identification. A creative consultant may need to be contracted for this exercise.

6.210   Infographics are particularly useful for telling stories to accompany data products. For example, if the agency is releasing a series of tables of census indicators, an infographic using the data can be produced to demonstrate to the user community or general public the

value of having such data. Infographics can appear electronically via the census agency's website or be printed in poster format for display.

6.211   To be effective, however, infographics require a number of elements. First, the infographic must use census data. If the census agency also produces data from other national surveys, those data can also be used in conjunction with census data to identify interesting topics for display. Second, the infographic must tell a story that is meaningful to the census agency or the country as a whole. For example, How has the population changed since the previous census? Or, Where are the most interesting or important patterns occurring within the country?

6.212   Third, infographics must use elegantly designed and easy-to-understand visuals. Effective data visualization is a skill often lacking in traditional education. However, with the rise of advanced visualization software and the enhanced visual functions of standard office software, producing meaningful graphics is technically accessible to most staff. Generally, infographics are left to professional graphic designers with a background in conveying information visually. For an example of a high-quality infographic that meets the three elements above, see figure XVIII.

6.213   As discussed already, interactive tools that produce custom graphics are increasingly popular for census products. Some tools are developed entirely for promotional purposes. Managers should recall that these tools require specialized skills to develop.

6.214   All promotional products should be developed in consultation with the subject matter experts of the original data products. Graphic designers are not necessarily data experts and may misconstrue the data or convey their message with meaningless cross-comparisons.

Figure XVIII

Sample census infographic from the United States

The shortened example below from the United States demonstrates the key characteristics of a census infographic: use of census data, an overarching and meaningful story or theme, and easy-to-understand visuals.

Source: http://www.census.gov/library/infographics/1940_census_change.html.
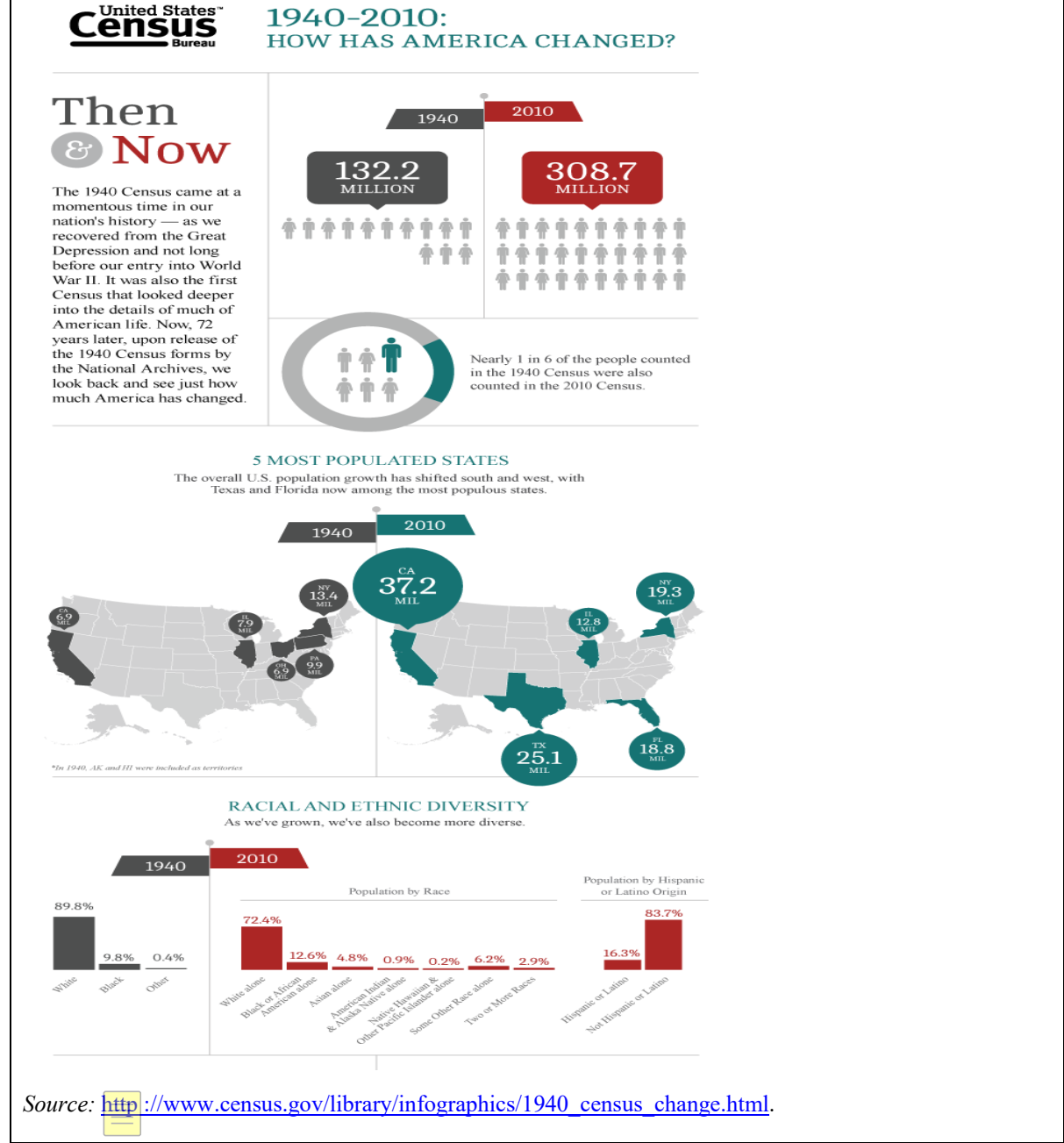
2.3   Branding

6.215   Depending on the size of a country and the effectiveness of census publicity efforts, thousands (or even millions) of individuals could view the products released by the census agency. Each time a user views the product, they should immediately recognize the source of

the product as the census agency. Repeated exposure to these products should not only inform users about the census results but also enhance the reputation of the census agency in their mind. Therefore, census agencies should take the appearance of their products seriously and consider applying uniform branding across all products, thus creating a distinctive national statistical office brand.

6.216   Branding extends beyond logos. Each product of the census agency should have a similar "look and feel" and a uniform corporate identity standard. These standards could be as basic as the type of font used in reports, or the colour scheme used to produce charts and graphs. For colour, a popular approach is to use the colours of the agency's logo or the country's flag. Regardless of font or colour, the key to branding is consistency from product to product. This consistency extends to both physical products and digital products.

6.217   In some countries, there will already be established standards for the presentation of statistical material by the census agency. In these cases, the census products should follow these guidelines as far as possible.

2.4   Release coordination

6.218   In most cases, the census results will only be one part (albeit an important part) of the product range of the agency. It is important that the output produced by the census be integrated as much as possible with the output from other collections conducted by the agency.

6.219   One way of achieving this will be to include dissemination groups for other major products of the census agency in the census product release scheduling. Furthermore, professionals from around the agency can be trained on how to use data from across a range of collections. This could be expanded to include integration in terms of statistical standards, dissemination structures, and computing systems, such as those for tabulation or manipulation of data and for GIS and cartography.

6.220   In addition, the use of other authoritative data for the country to validate the census data will help to ensure that the census data are seen as part of a larger package, and not simply as a self-contained set of numbers.

3.   Product launch and support

6.221   The product launch phase is more than simply releasing the product. Before release, the product must be validated and reviewed for error. This stage is especially important since it is the last opportunity to prevent errors from appearing in official products. Furthermore, the product launch itself requires the coordination of multiple units within the census agency to effectively publicize and promote its availability. Continuing training and support may be necessary, depending on the complexity of the product and resources available. Throughout this process, the census agency must evaluate and review the status of its released products to ensure their continued usefulness.

3.1   Pre-release validation and review

6.222   A key management objective should be to ensure that all processes used in the production of output from the census itself are tested and reviewed before their use in a production environment or public release. The primary goal of review, which should adhere to the agency's statistical standards, is to ensure census products released to the public are of the highest quality and accuracy. If the census agency releases products without a formal review process, the agency risks its reputation if significant errors (or even many small errors) are detected that have to be corrected later. The best procedure is to avoid releasing census products with such unacknowledged errors in the first place.

6.223   As indicated elsewhere in the present handbook, timeliness is a key attribute of quality. The timetable for, and activities involved in, the validation and production processes should be developed in consultation with all staff members working in the dissemination projects of the census (and other projects that are stakeholders of dissemination). The procedures should also be fully documented. In the case where errors or biases are known in the underlying data used in products (for example, sampling error, non-sampling error), such errors should be acknowledged and documented by the census agency for public review.

6.224   For software systems, procedures for data validation and software acceptance testing must be implemented to ensure the detection and correction of any defects. The strategies should be oriented towards establishing a system with the objective of preventing errors or defects from occurring. In contrast to earlier stages of the cycle, it is probable that any errors identified in the output quality assurance process indicate a failing of the system. Thus, if (or when) errors are identified, the system must be checked and revised and tables rerun to remove errors.

3.2   Product launch

6.225   Products and services should be launched to ensure maximum community awareness of data availability. The product launch should be widely publicized using all of the promotional activities, including the agency's website, social media and press releases. The marketing and public relations departments generally coordinate product launches. If the product is being launched in person, a high-profile government or business personality may be invited to open the proceedings to ensure maximum media attention.

3.3   Training and support

6.226   It is probable that the census agency will be involved in resolving user queries about the interpretation and use of its data. Establishing a customer service unit will help users to engage with the census agency and use its data more effectively. Customer service should be available through the nation's most popular communications channels, including email, telephone and physical mail. Dedicated service for a particular customer or highly specialized requests requiring a burdensome commitment by the census agency to resolve may be handled on a cost reimbursement basis.

6.227　Certain data products, especially some data query and retrieval products, may be so specialized as to require dedicated training. Training and instruction can be provided through several means, including documentation provided online or with the product (if disseminated using physical media), instructional videos posted to the agency's website, or in-person workshops. Each of these means can be challenging to implement, so managers should ensure that only the minimally necessary level of training is provided to keep products cost-effective.

3.4　*Evaluation and continuing review*

6.228　Evaluation allows the agency to monitor the performance of products and services and to ensure that user needs are being met. It is therefore essential to regularly evaluate the interaction of all products and services between the census agency and user community. With evaluation and continuing review, the agency can keep up with changes in the marketplace and identify improvements and other opportunities.

6.229　Monitoring product and service use may involve analysing their flow physically or electronically. For physical products, such as compact discs and books, inventories can be monitored and shipments measured in terms of units. For electronic dissemination, one of its great advantages is the ease with which the census agency can move data products to the public. However, this ease also presents challenges for monitoring use. Some products, such as data tables, can be tracked by number of downloads using commercial analytics software. However, once the product is downloaded, tracking redistribution by third parties is difficult. Other products, such as interactive visuals, can be tracked by number of page loads or impressions on social media websites.

6.230　Maintaining user consultation is also important. As shown above, measuring the use of census products with technology alone risks overestimating or underestimating their actual use. Therefore, managers should employ the user consultation methods outlined earlier in the present chapter as another measure of the continuing use of census products. Such consultation may take place on a defined cycle, such as quarterly or annually, to ensure regular feedback without overburdening the user community.

6.231　Census agency managers must consult with their public relations and marketing specialists, or contract with private marketing specialists, to ensure their product utilization is being effectively measured. Such measurements can be used to justify the budget of products or reallocate resources elsewhere if certain products are not being used heavily.

6.232　The product launch and support phase should furthermore put in place procedures for managing situations where public questions are raised, or controversies are created, about census data. The census agency must take a proactive role in communicating the limitations and strengths of census data so that users are fully informed.

4.   Closeout

6.233   The closeout stage of the product phase is critical for both the current census and future censuses. During closeout, managers should confirm with their staff that all product deliverables laid out during the planning stage have been met. Managers should also ensure that their staff have thoroughly documented their procedures and archived important workflows, algorithms and data sets for future use.

4.1   Ensuring that deliverables are met

6.234   Throughout the product phase, managers have been closely monitoring and evaluating the progress of the census products being released to the user community. As each product is completed, reviewed, and submitted for release, managers should regularly follow up to confirm the product has actually been released through the planned medium (for example, print or Internet).

6.235   Lower-priority products are often set aside to focus resources on primary products, such as the detailed census results. These lower-priority products may be forgotten or misplaced as time passes, so managers should confirm their status (for example, if they are cancelled or will resume work) before the census product phase is officially concluded.

4.2   Documenting processes and lessons learned

6.236   The cumulative experience of past censuses in a country is very useful in the preparation of a new census. Because of the lapse of time between censuses (generally 10 years) and the likelihood that experienced staff may leave the census office, it is essential that there be a comprehensive record of how the census was planned, organized and conducted.[110] Consequently, managers must prepare documentation pertaining to the product phase to assist future census and survey staff. The amount of information to document will depend on the census agency and country, though some common examples include the following.

(a) **Procedural history.** A detailed account should be kept of the events during the product phase, including successes and failures. Documenting failures is especially important to prevent their reoccurrence.

(b) **Lessons learned.** Challenging situations that appeared during the product phase, and the actions taken to correct the problem, will provide lessons for future censuses. Ideally, these lessons learned will save time later.

(c) **Project management documents.** The key documents used for managing the project should be retained, such as the project charter, work breakdown structure, and any other documents containing information about the processes and activities of the product phase.

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[110] Ibid., para. 3.468.

(d) **Stakeholders.** A list of key stakeholders and users may be useful for the next census, especially for the consultation phase.

(e) **Contracts.** Important contracts and other documents between the census agency and external parties (such as private vendors or other ministries) should be retained as required by law and for future reference.

4.3   Archiving materials

6.237   At the conclusion of the product phase, all of the finalized products should be retained for future reference. Managers will need to consult with their staff to determine the amount of working materials and methodology documents to retain in the context of future usefulness.

6.238   A retention period should be specified for all digital data, supporting software or algorithms, and documentation to ensure that a service can be offered to users in the future. This task should be the responsibility of the area of the census agency that produces the data, which could include:

(a) Statistical data for internal (census agency) use, that is, current data retained because of a need for further use in processing, backup or input to other areas;

(b) Copies of base material produced for output products to enable recompilation of those products, if required, for disaster recovery or other functions;

(c) Non-statistical data, that is, programs, test packs, metadata (data describing data) and reference data required to support statistical data systems or as an information source.

6.239   The details of such an archival strategy will be greatly influenced by a wide range of factors, including the IT culture and facilities of the country and the census agency. The nature of the data files created in the dissemination phase and the laws of the country relating to storage of official records will also have an influence.

6.240   More information on archiving is provided in chapter VIII.

VII. Evaluation

A.   Introduction

7.1   A census evaluation programme consists of activities aimed to cover evaluation of both the quality of data and the quality of census processes. A standard feature of census evaluation should be a review of each of the major phases upon completion. This can identify strengths and weaknesses and make recommendations for investigation or redevelopment in the following census cycle.

7.2   The census needs to be evaluated to ensure that the effort and investment of resources have been worthwhile and to provide users with information on the quality of the resulting census statistics. With so many different activities involved, the evaluation of such a project is a complex exercise. The census represents a rich source of information about contemporary populations. It is widely used by Governments and large numbers of users outside government administration. Therefore, evaluation of the census should make fundamental measurements of data quality in order to assist in understanding the quality of the census data and interpreting the results.

7.3   Despite all efforts to ensure quality, the population and housing census is not perfect and errors can and do occur at all stages of the census operation. Census managers can use the results of a census evaluation to improve the quality and cost-effectiveness of each process of the operation for future censuses. Reviewing the evaluation of the previous census should be the first step in the census cycle.

7.4   The evaluation can be viewed as having two broad objectives. These are to ensure that the quality of results meets the requirements of the key users of census data and that each process in the operation contributes in a cost-effective way to achieving the desired level of quality. The outcomes of the evaluation process should be communicated to the users of census data, as well as to the managers of the census.

7.5   The evaluation of census data can be undertaken at two levels: (a) basic measurements of the overall quality at a broad level; and (b) a more detailed level of investigation, where in-depth analysis of selected topics is performed. These topics can be determined on the basis of (a) continuing interest in the topic; (b) lack of recent examination of a topic; (c) considerable change since the previous census; and (d) generating lessons learned for use in the development of the next census.

7.6   Box 34 presents a summary of the purpose of census evaluation.

Box 34. Purpose of census evaluation

Evaluation efforts focused on census results should generally be designed to serve the following objectives: first, to provide users with some measures of the quality of census data to help them to interpret the results; second, to identify as far as is practicable the types and sources of error in order to assist the planning of future censuses; and third, to serve as a basis for constructing a best estimate of census aggregates, such as the total population, or to provide census results adjusted to take into account identified errors at national or subnational levels if some errors such as coverage error are substantial and the validity of census results is questionable.

As the decision to adjust census figures is sensitive, it is bound to be decided at the highest levels of the government bureaucracy. There is also some critical statistical consideration that should be very carefully weighed in. Consideration must be given to what geographical domains the adjustment would cover, knowing that such adjustments have an effect on demographic distributions.

The final publication of census results should include an estimate of coverage error, together with a full indication of the methods used for evaluating the completeness of the data. The publication should also provide users with some cautions or important notes about the results, in addition to some guidance on how they might use the evaluation results. It is also desirable to provide, as far as possible, an evaluation of the quality of the information on each topic and of the effects of the editing and imputation procedures used.

Source: Principles and Recommendations for Population and Housing Censuses, Revision 3, paras. 3.212–3.214.

B.   Planning and implementation

7.7   Evaluation should be a continuing process that occurs at every stage of the census. A soundly managed census will include quality assurance and improvement procedures in each of the major phases of the census (planning, questionnaire development, mapping, enumeration, data capture and processing, editing, and dissemination). Quality assurance was discussed in various previous chapters (chap. II, sect. N; chap. IV, sect. D; chap. V, sect. F; and chap. VI, sect. D). Continuing quality assurance procedures are crucial to monitor performance during the operation and make certain that any tendency to fall below accepted standards is corrected as work proceeds.

7.8   The scope of the census evaluation programme should be decided during the census-planning phase. The scope might include:

   (a) Evaluating the quality of each operational process, for example by using key process variables such as item non-response rate, data capture errors, coding errors and imputation rates;

   (b) Estimating coverage error at national, regional and provincial levels;

   (c) Analysing content errors of data such as age misreporting;

   (d) Assessing non-response rates and refusals to provide information;

(e) Comparing census data with previous censuses, administrative data, and household surveys.

7.9   The census evaluation should be part of the overall census plan, be budgeted, and have personnel allocated. The census evaluation team should be established early in the planning phase. The team should consist of staff with experience in different census processes and census topics, including demography, education, housing and the labour force. Members of the team should also have training in various evaluation techniques. Background knowledge of historical events and changes in population structure in the country is also helpful.

7.10   Changes to any of the census processes have the potential to affect the quality of the final data. The census evaluation team should assess all changes to the enumeration form and major phases of the census. Assessment of changes to the enumeration form may amount to a simple task if there are minor changes to wording or instructions. However, the inclusion of a new topic should warrant a thorough investigation of the new data and establishment of benchmarks for future reference.

7.11   Changes to the enumeration process and processing systems, including coding, edits and derivations, should be closely monitored throughout the census. Continuous data quality management and quality improvement practices are discussed in chapter II, section N. The role of the census evaluation team is to review data quality management reports from major phases of previous census cycles and compile lists of recommendations for improvements for the next census.

7.12   The evaluation team should seriously consider issues raised in the planning and preparatory phases for the next census. If data are available, an assessment of past practices should reveal strengths and weaknesses of the system. Alternatively, if there are no available data, new strategies to monitor identified points of weaknesses should be developed. Subsequently, the information obtained through the new monitoring strategies should be evaluated prior to the development of the next census. All issues identified in any of the phases of the census should be reviewed prior to the development of the next census.

C.   Basic measurements of overall quality

7.13   At the broad level of census evaluation, two aspects can be considered: (a) process quality; and (b) data quality. Data quality is usually dependent on the quality of census processes. Therefore, improving process quality is a precondition for better data quality, at an acceptable cost.

1.   Process quality

7.14   Because of the size and complexity of census operations, it is likely that errors of one kind or another may arise at any stage. These errors can easily lead to serious coverage or content errors, cost overruns or major delays in completing the census. If not anticipated and

controlled during implementation, they can introduce errors to the point of making results useless.

7.15   Given the fact that the census operation includes interrelated and interlinked processes, the output of one process is usually the input of the next. Consequently, the census quality assurance programme[111] should take into account all processes for ensuring the quality of the census outputs. There is, therefore, a need for a continuous quality assurance programme that allows systematic monitoring of census processes for the aim of improving the quality of each process, including pre-enumeration, enumeration, document flow, coding, data capture, editing, tabulation and data dissemination.

7.16   It is important that an evaluation take place at the end of each phase of the census. This should be done for all phases, so that strengths and weaknesses of operational procedures can be carefully reviewed and this experience can be carried forward to the next census. While the content of the evaluation of each process differs according to the census methodology and technology used, it can be organized in such a way that it covers the following issues:

(a) Variables that were selected for monitoring process quality;

(b) Systems for collecting information during operations;

(c) Types of errors that occurred at each phase;

(d) What actions were taken to improve procedures;

(e) If errors were corrected, why this decision was taken;

(f) Effects of improving procedures or correcting errors on the cost, time and quality of the outputs of the process;

(g) Challenges and suggestions for the next census.

2.   Data quality

7.17   The main objectives of evaluation of data quality are:

(a) To measure the level of accuracy of census data;

(b) To identify the types of errors;

(c) To measure differential undercoverage;[112]

(d) To serve as a basis for constructing the best estimate of census aggregates, such as total population, number of births and number of migrants.

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[111] See chap. II, sect. N, of the present handbook for information on quality assurance.

[112] Reference is made here to the differences in coverage of dissimilar population groups, such as young adults, undocumented migrants and others.

7.18   Errors in census data can be classified into two categories: coverage errors and content errors.

2.1   Coverage errors

7.19   It is normal practice for a census to aim to cover 100 per cent of the population. However, in practice this will rarely be achieved and differentials in coverage errors are often observed for different population groups. Coverage error is the error in the count of persons or housing units resulting from cases having been missed during census enumeration or counted erroneously. In order for the results of the census to have validity, some attempt should be made to assess the extent to which the count has missed or duplicated people.

7.20   The main reasons for coverage errors are:

  (a) Incomplete or inaccurate mapping;

  (b) Access difficulties;

  (c) Population in transit or difficult to enumerate;

  (d) Errors in communicating census requirements to the public;

  (e) Misunderstanding of definitions and instructions by enumeration staff owing to inadequate training;

  (f) Lack of quality assurance in the enumeration activity, including inadequate coordination and supervision.

7.21   There are three types of coverage error: omission, duplication, and erroneous inclusion.

(a)   Omission

7.22   Omission occurs when census enumeration misses persons, households or housing units. People can be missed if parts of the country have been excluded from the mapping system because of poor coverage. Some households may also be missed as a result difficulties in access. This predominantly applies to remote, flood-affected or mountainous areas. Inadequate mapping of urban areas may cause omission of private dwellings in non-residential or relatively sparsely populated areas.

7.23   In addition, the possibility of omission is high for certain populations. These populations include:

  (a) The homeless;

  (b) Persons with more than one place of residence;

  (c) Nomadic populations;

  (d) Ethnic minorities;

  (e) Undocumented migrants;

(f) Highly mobile segments of the population (such as young people or migrant labourers);

(g) People who change residence during census enumeration;

(h) People living temporarily in hotels or boarding houses.

7.24   Lack of understanding of the census instructions may also result in omission. For example, misinterpretation of the coverage instructions may result in exclusion of infants, the elderly, visitors[113] or domestic help. In some cases, this may reflect cultural beliefs and thus census managers should issue explicit instructions on how to enumerate these populations instead of relying on ad hoc decisions by enumerators.

7.25   In countries where persons are enumerated on the basis of usual residence, the failure to include members of the household who are temporarily absent will add to omission. For example, this could include persons on short periods of work away from home, away from home on holiday, in hospital or in prison (for relatively short periods), or with no fixed address.

7.26   Furthermore, confidentiality concerns may lead to omission. For example, in countries with military conscription, these concerns may result in a significant undercount of young males.

7.27   Good organization, training and supervision will minimize omission caused by the erroneous assessment of dwelling units classed as being unoccupied or, in cases of non-contact with occupants, by the occupants being away when the census enumerator calls. Further, completeness of mapping and accurate delineation of enumeration areas are important in reducing omission errors.

(b)   Duplication

7.28   Duplication occurs when persons, households or housing units are enumerated more than once. Errors in mapping may lead to duplication if enumeration areas overlap. Highly mobile or young persons may be included on the census form in more than one household if they are perceived by the members of more than one household to be usual occupants. Similarly, students studying away from home may be counted once at home and again at the place of education. If there is a long enumeration period, the chances of duplication increase, since the population may move during the enumeration period. Good organization and supervision, as well as accurate mapping, should minimize duplication errors.

(c)   Erroneous inclusions

7.29   Erroneous inclusion occurs when persons, households or housing units are enumerated in the census when they should not have been or when they are enumerated in the wrong place. Some examples of groups commonly included erroneously are the following:

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[113] In census counts based on the usual resident population, visitors are excluded by design.

(a) People on long-term stays in hospitals or prisons;

(b) Members of defence forces on long-term postings away from their families;

(c) People on long-term holidays;

(d) Foreign diplomats and their families;

(e) Persons who died before census day;

(f) Persons staying abroad or elsewhere during census enumeration (for de facto censuses);

(g) Household members working abroad for extended period of time.

2.2   Content errors

7.30   Content error results from incorrect reporting or recording of the characteristics of persons, households or housing units. Content errors may be caused by a number of factors, as discussed below.

(a)   Errors in questionnaire design

7.31   Poorly phrased questions or instructions and poor sequencing of questions may lead to content errors. Errors in translation in cases of countries using multiple languages could give rise to content errors. As discussed in chapter III, errors in questionnaire design cannot be corrected after enumeration. Careful pretesting should minimize content errors resulting from errors in questionnaire design.

(b)   Enumerator errors

7.32   The enumerator can make mistakes when asking the questions. They may abridge or change the wording of the questions, skip some questions, or may not fully explain the meaning of the questions to the respondent. The enumerator may also make mistakes in recording the responses. Some amount of enumerator error is unavoidable. However, sufficient training of the enumerators and close supervision and quality assurance during the enumeration should reduce enumerator errors. If using an electronic questionnaire, census managers can use questionnaire software to build in basic range and consistency checks to minimize enumerator errors.

(c)   Respondent errors

7.33   Respondent errors occur when respondents misunderstand questions, deliberately misreport information, or choose not to answer questions. The chances of respondent errors increase in proxy responses, for example when the head of household answers questions about the fertility history of his daughter-in-law. Respondent errors can be reduced through good publicity for the census and proper training of the enumerators.

(d)   Coding errors

7.34   Coding errors occur during the coding process when the coder may miscode information. Precise, detailed instructions for coding should be prepared before the

enumeration. Using precoded response options in the questionnaire reduces the chance of coding errors. Spot checks and verification of samples from each coder may decrease coding errors.

(e)   Data capture errors

7.35   Data capture errors can arise during the process of converting information obtained in the census to a format that can be used by a computer. Data capture can occur during manual entry or scanning, or when entering responses in a digital questionnaire. Mistakes in keying are often the source of error in manual entry or when using a digital questionnaire. Range checks and basic consistency checks can be built into data entry software to prevent invalid entries. Verification of keying through rekeying of a sample of forms also improves the quality of the data. These topics are discussed further in chapter V. Errors can also happen during scanning if the scanner incorrectly recognizes a character or mark. Verifying the scanning process early in the cycle is important so that errors can be caught and corrected. Without verification, systemic errors can corrupt the data.

(f)   Errors in editing

7.36   The census-editing process replaces missing, invalid or inconsistent data with plausible data through imputation. While the intent of editing is to correct invalid or inconsistent data, the editing process may introduce new errors.

(g)   Errors in tabulation

7.37   Errors may occur in the tabulation stage owing to improper programming or use of unknown information. Errors at this stage are difficult to correct without introducing new errors. Careful review of the tabulations is critical.

(h)   Errors in publication

7.38   As detailed in chapter VI, errors can also be introduced in the publication stage as a result of lack of intertabulation checking or printing errors. Errors in publication can diminish the value of the data and the credibility of the organization. Census managers should check each publication thoroughly before public release. Aggregate checks after tabulation, sometimes called macroedits, are useful in catching errors. Trained and experienced persons should review the different tables to check whether the reported numbers in different cells are consistent with the known local situation.

D.   Methods of evaluation

7.39   A wide range of methods is available for evaluating the census.[114] The methods used for evaluating the census will depend largely on the types of error to measure (for example, coverage versus content error), data availability, and the level of technical and financial

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[114] The text of the section on methods of evaluation was prepared on the basis of *Post Enumeration Surveys: Operational Guidelines*, Technical report, United Nations Statistics Division, New York, 2010.

resources available. Understanding the various types of available methods early in the census life cycle will allow census managers to plan accordingly.

7.40 There are a number of methods used to evaluate censuses, including demographic analysis, interpretation studies of the current census, record checks, comparison of census data with results of existing household surveys, and post-enumeration surveys. Evaluation methods differ with respect to technical sophistication, data requirements and quality of results.

1. Demographic analysis of census results

7.41 By undertaking demographic analysis, results from a census may be compared with data from other demographic systems, such as vital registration of births and deaths, including net migration if such data are available. The cohort component method of demographic analysis uses data from successive censuses as well as life table survival rates, age-specific fertility rates, and estimated levels of international migration between censuses. The population is projected forward to the reference date of the second census on the basis of estimated levels and age schedules of fertility, mortality and migration, and the expected population is compared with the enumerated population in the second census.

7.42 Another method of analysis involves comparing the age distributions of successive censuses. This method is widely used because it requires few data. Yet another method in use is the cohort survival regression method, which uses population counts by age from two censuses and deaths by age during the intercensal period to estimate coverage rate.

7.43 In general, population characteristics from the current census are compared with characteristics from other independent sources such as the vital statistics register, if a country has one, or other external models such as the projections from the previous censuses. For an overall assessment of census quality, data on sex and on age groups or age cohorts can be used. The age pyramid is another example of a standard method of demographic analysis. Stable population analysis can also be undertaken as long as certain assumptions are met, such as constant fertility and mortality rates and a closed population with no migration into and out of the population. In countries where mortality has been declining, a quasi-stable model may be appropriate.

2. Interpretation studies on the current census

7.44 This method involves drawing subsamples, selected in an identical manner, from the census frame, with each subsample capable of providing a valid estimate of the population parameter. Assignment of census personnel (such as enumerators, coders and data entry staff) is also done randomly. This method helps to provide an appraisal of the quality of the census information, as the interpenetrating subsamples can be used to secure information on content error. In censuses and surveys, non-sampling errors can result from various factors, including differential interviewer bias or different methods of eliciting information. After the subsamples have been enumerated by different groups of interviewers and processed by

different teams of workers at the tabulation stage, comparison of estimates based on the subsamples provides a broad check on the quality of the census results. The results from such studies could be useful in improving the operations of future censuses and large-scale sample surveys.

3.   Record checks

7.45   In this type of analysis, census records are matched with a sample of records from the vital registration or other identification systems, where the relevant respondents to the census questionnaire are traced to the time synchronized with the census. Such sources include previous censuses, birth registrations, school enrolment registries, voter registration lists, health and social security records, immigration registers, and national or citizen registration cards. Both coverage and content errors can be measured through such comparisons. For coverage evaluation purposes, the following preconditions are necessary: (a) a large proportion of the census target population should be covered in the record system; (b) the census and record systems should be independent of each other; and (c) there should be sufficient information in the records for accurate matching. For content evaluation purposes, the record system should contain some relevant items covered in the census, such as age, sex, education and income. It is important to ensure that the definitions of items are the same. Countries that have used record checks include Canada, Denmark, Finland, Guatemala, Honduras, Israel, Italy, the Netherlands, Norway, Sweden, and Taiwan Province of China.

4.   Comparison with existing household surveys

7.46   Theoretically, any probability sample of households or individuals can be used to evaluate coverage and content errors in a census if they have some identical items with the same concepts and definitions. However, the post-enumeration survey is specifically designed for that purpose and is therefore the most suitable means of evaluating coverage and content errors. In the absence of a post-enumeration survey, other households survey results can be used to evaluate census results, provided the principles of independence from the census and closeness to the census date are upheld. In addition, there should be sufficient identical information to perform accurate matching. For content evaluation, it is essential that several of the same data items be collected. Household surveys conducted in many developing countries may not fulfil most of the above prerequisites.

5.   Post-enumeration surveys

7.47   According to the *Principles and Recommendations for Population and Housing Censuses, Revision 3*, paragraph 3.221, the post-enumeration survey is a complete re-enumeration of a representative sample of a census population followed by matching each individual enumerated in the post-enumeration survey with information from the census enumeration. The results of the comparison are mainly used to measure coverage and content error in the context of the census. Some countries only confine the post-enumeration survey to evaluating coverage error. Coverage error refers to housing units and people missed in the

census or those erroneously included. On the other hand, content errors evaluate the response quality of selected questions in a census and are also a basis for evaluating the reliability of some characteristics reported in the census.

7.48   In general, an evaluation of the magnitude and direction of errors in a census is necessary in order to present to users the extent of reliability and accuracy of some characteristics reported. The evaluation, therefore, allows for better interpretation of census results by presenting limitations to users, which it achieves through quantitatively evaluating the accuracy of census results with respect to coverage or quality of responses to questions on selected variables. For some countries the results of the post-enumeration survey results are used to adjust census results if, for instance, there is evidence of major coverage errors.

7.49   It should be pointed out that for many developing countries, basic data to facilitate census evaluation are lacking or insufficient. For example, to undertake a demographic analysis there is a need for very reliable data to enable calculation of the demographic components of the population, namely fertility, mortality and migration. In some developing countries these data are not available. In addition, many developing countries do not have comprehensive vital registration systems, so sophisticated demographic analysis to evaluate the census may not be feasible. The use of interpenetrating studies and results from household surveys assumes that a country has a dynamic and well-developed survey programme, the results of which can be used to evaluate the census. For many countries this is not the case. Post-enumeration surveys are important in evaluating coverage and content error in censuses, especially in developing countries.

7.50   Detailed explanations on the methods of evaluation are provided in the technical report on post-enumeration survey operational guidelines.[115]

E.   Communicating data quality issues

7.51   The census agency must take a proactive role in communicating the reliability and shortfalls of the census data to enable their informed use. Users should be fully aware of the limitations and strengths of the final data. It is important that users understand the impact of any changes made to census procedures on any analysis they may wish to perform. Therefore, the outcomes of evaluation have to be disseminated effectively.

7.52   There are two ways to approach this task. A formal approach involves compiling publications addressing various issues, preferably published in a series of census evaluation papers or fact sheets. This type of dissemination may take advantage of different media, including the Internet and emerging technology. Informal communications can include ad hoc reports, presentations given to interest groups, articles in census newsletters or census updates, and answering queries from users. To fulfil the last requirement, it is necessary that complete evaluation reports be accessible to staff dealing with users. This can be facilitated

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[115] *Post Enumeration Surveys: Operational Guidelines*, Technical report, United Nations Statistics Division, New York, 2010.

by a computerized database, where the census documentation can be permanently stored and easily accessed when needed.

7.53   Box 35 presents country examples of post-enumeration surveys from India and Nepal.

Box 35. Country examples of census evaluation: 2011 censuses in India and Nepal

Census of India, 2011

The Indian Census Organization evaluates the results of the population census through post-enumeration surveys. For the 2011 census, a post-enumeration survey was conducted through independent state government agencies, namely the Directorate of Economics and Statistics and other government organizations not associated with the population enumeration activities. The survey was conducted in 4,000 enumeration areas covering all states and union territories within three to four months of the completion of the population enumeration.

The report on the post-enumeration survey for the 2011 census presented information on the extent of omission and duplication in the census enumeration, and response errors for certain selected characteristics canvassed during the census. The results of the post-enumeration survey are valuable for highlighting the areas of the census operations that need attention when conducting future censuses.

Census of Nepal, 2011

An independent assessment of the 2011 census operations of Nepal was undertaken by civil society. A committee comprising independent demographers, university professors and lecturers, civil society, and representatives of various ethnic groups undertook the survey of the census fieldwork. The observation exercise was implemented as a project financed by the United Nations Population Fund (UNFPA) Nepal, Switzerland, and the Netherlands Development Organization. The project employed 340 observers who visited 77 census districts. The observers were trained and provided with a structured questionnaire to interview census staff and selected respondents. They were instructed not to engage while census interviews were taking place in the field. The independent observation of the census of 2011 was the first of its kind in Nepal. The report submitted by the committee to UNFPA found general satisfaction with the quality of coverage of the census operations.

For the post-enumeration survey, fieldwork was conducted in September 2011, three months after the main census. UNFPA Nepal provided technical assistance for one international consultant and one national consultant to conduct the post-enumeration survey. The international consultant prepared a sampling design and a post-enumeration survey questionnaire. Initially, the sampling design was prepared using the 2001 census. This was later updated by using the preliminary results of the 2011 census and sampling weights were calculated accordingly. The sample size for this survey, owing to time constraints, was fixed at 10,000 households. The underenumeration rate was estimated to be around 3.63 per cent in the census of 2011 compared with 5.3 per cent in 2001. The rate was higher in urban areas, especially in the Kathmandu valley. The post-enumeration survey report identified a problem in matching the information to individuals between the census and the post-enumeration survey. It was therefore suggested that the post-enumeration survey should be conducted immediately after the census in order to minimize the effects of migration, especially in urban areas. Preparation for the post-enumeration survey should thus commence in tandem with the census.

VIII. Documentation and archiving

A. Introduction

8.1   The overall purpose of establishing and maintaining thorough and meticulous documentation of a project of such magnitude as the national population and housing census covers more than one dimension. It is necessary in order to ensure the solid basis for conducting the next census; it is critical for assessing the efficient use of significant resources and bookkeeping; and it provides invaluable additional information to users of census statistics throughout the lifetime of these statistics. Furthermore, it is a necessary component of all methodologies as applied in the context of official statistics. Documenting every step of the way in a comprehensive and objective manner therefore constitutes an essential part of the census project.

8.2   Consequently, planning for the development of a comprehensive documentation process needs to be undertaken at the very beginning of the preparations for the national population and housing census.[116] Documenting each phase and activity of the census needs to be incorporated in the overall management and organizational structure, with clear and unambiguous assignment of responsibilities at each management and organizational level.

8.3   Archiving refers to ensuring the preservation of relevant census materials, primarily census records. Archiving procedures and protocols for the population and housing census statistical materials would not be different from other statistical exercises under the auspices of the national statistical authorities. However, archiving individual records is peculiar to the census, as these would cover all the population of the country; thus, the need to develop specific procedures.

B. Documentation

8.4   In general, there are two classes of documentation that needs to be maintained and preserved during the population and housing censuses. The first refers to the documentation of operational activities and the second to the documentation accompanying census statistics, including metadata.

1. Documenting census operations

8.5   The census project management should, therefore, plan for and implement a knowledge management system to assemble complete records on plans, activities, and decisions taken during the entire census operation. This would entail documentation and archiving of information related to plans and their implementation, as well as problems encountered and how they were resolved at each stage of the census cycle. It is recommended that documentation of census experience be undertaken at each stage of the census operation

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[116] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.469.

and not be left until the end of the census process. This would include plans, decisions and activities related to preparatory activities, the methodology of the census, fieldwork or other data collection activity, data processing, cost and implementation of the census budget, and evaluation of performance of each of these activities, as well as notes from meetings. Examples of items to track or monitor include implementation of activities, time taken to complete an activity, resources used and cost. All these should be assessed against set goals so that changes to plans can be recorded, including information on what changed and why. Tracking and systematically recording the census experience should also take into account risks encountered and how these risks were managed.[117] The practice of developing and maintaining a risks register and accompanying contingency plans and mitigation strategies is extremely valuable, not only for the next census operation but also for other statistical data collection programmes.

8.6   A more detailed elaboration on the process of documenting census operations is provided in chapter II, section M, of the present handbook. However, it has to be emphasized that systematic recording of census experience is not an end in itself. Thus, every country should prepare and, if possible, publish an administrative and methodological report, as a census "historical memory", on the basis of information that has been recorded in the knowledge management system.[118] Depending on the methodology of the census, the administrative and methodological report should contain information on the manner in which the census was planned, organized and conducted, as well as important methodological and other problems encountered at various stages of the programme. As appropriate, the report should provide specimens of the census questionnaires and forms, instructions for the enumeration, and detailed information on the cost of the census and on the implementation of the census budget, as well as points to be considered in future censuses.

8.7   The structure of the report could be similar to the structure of the project plan. It is important that the report be as comprehensive as possible, covering all stages and aspects of census planning and operations, including fieldwork, processing, analysis, dissemination and evaluation. It is important to note that while such a report would be based on items and information in the knowledge management system,[119] it may not necessarily contain detailed descriptions of all the processes or information, as some may be for internal use only. This report would both assist the users of the census results in appraising and interpreting the data

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[117] Ibid., para. 3.469.

[118] See *Principles and Recommendations for Population and Housing Censuses, Revision 3,* paras. 3.325 and 3.326.

[119] While email exchanges are an indispensable tool used for daily communication between staff, it has to be emphasized that email archives cannot replace proper documentation procedures. Emails need to be structured and catalogued; hence, a raw and unprocessed email archive would be cumbersome and time consuming to interpret. Only structured documentation has the necessary attributes to allow for efficient navigation.

and facilitate the proper planning of future data collection programmes, including population and housing censuses.[120]

2.   Documenting metadata

8.8   An important component of any country's programme of disseminating the results of its census is a comprehensive portfolio of supporting documentation and metadata to help to explain, clarify and enhance the value of statistical outputs, in particular with regard to making comparisons with previous censuses and other data sources (see note ECE/CES/GE.41/2013/7).

8.9   Metadata comprise descriptive and structured information or documentation about data that informs users about the content, quality and condition of data. In this context, metadata provide guidance on the proper usage or interpretation of data by providing information on the processes of production and describing the structure of data sets, thereby making it easier to retrieve, use or manage the data. Metadata also provide the basis for assessing the international comparability of data. Metadata constitute a standardized way of organizing data and can be categorized as follows: (a) reference metadata, which allow understanding and interpretation of the corresponding statistical data by describing the concepts, definitions, methodology and quality of data, production and dissemination processes, data access conditions, etc.; and (b) structural metadata, or "data about data", which provide information about the structure of the data set and act as identifiers and descriptors of the data, making it possible to properly identify, retrieve, browse and further process the data.[121]

8.10   All tabulations should include the following metadata or references to where this information can be obtained: census questions; reasons why they are asked; conceptual definitions (census dictionary); geographical hierarchies used; changes since the previous census with regard to content, operational methods or geographical boundaries; and quality indicators such as coverage rates and item non-response. Data files must also be accompanied with metadata, including names and codes for common variables, personal files and household files. If a long-form sample is used in the census, metadata should also provide information on the sampling variability of the results. When the census tabulations include suppressed data cells due to small numbers, the metadata should also include a methodological note on the rules and methods of suppression. Metadata should be preserved for future reference. With the increased use of technology, properly designed metadata systems for web-based applications are strongly recommended.[122]

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[120] *Principles and Recommendations for Population and Housing Censuses, Revision 3*, para. 3.472.

[121] Ibid., para. 3.291.

[122] Ibid., para. 3.293.

8.11   Examples of metadata and documentation produced to support census outputs in the countries in the ECE region in the 2010 round of population and housing censuses are as follows:[123]

    (a) Explanatory noted to tables;

    (b) Definitions of concepts and terms used;

    (c) Methodological papers and reports;

    (d) Data visualization, including maps, graphs and charts;

    (e) Census questions;

    (f) Changes to definitions since previous census;

    (g) Levels of response;

    (h) Levels of imputations – overall, for each topic, for each area, and for each level of geography;

    (i) Data dictionary and glossary of terms;

    (j) User guides;

    (k) Comparisons with other data sources;

    (l) Commentary;

    (m) Coverage adjustments;

    (n) Confidence intervals;

    (o) Other documentation and metadata.

8.12   Box 36 gives an example of use of technology for archiving from the 2000 and 2010 censuses of Cabo Verde.

Box 36. Technology platform for archiving the 2000 and 2010 censuses in Cabo Verde

Cabo Verde utilized the Microdata Cataloging Tool of the National Data Archive (NADA) to archive its 2000 and 2010 census data and documentation. NADA is a web-based cataloguing system that serves as a portal for browsing, searching, filtering, comparing, accessing and downloading census or survey data and documentation. This platform allows INECV to build and preserve a strong institutional memory related to censuses, and supports the web dissemination of census-related information. The census documentation available on the portal includes questionnaires, awareness reports, methodological reports, fieldwork manuals, variable dictionaries, metadata associated with the variables, and thematic analysis reports.

Source: Instituto Nacional de Estatística, Cabo Verde.

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[123] *Measuring Population and Housing: Practices of ECE Countries in the 2010 Round of Censuses*, Economic Commission for Europe, Geneva, 2014, table. 6.6.

C.   Archiving

8.13   The term archiving refers to a wide variety of storage and preservation functions and systems.[124] Traditional archives are understood as facilities or organizations that preserve records, originally generated by or for a government organization, institution, or corporation, for access by public or private communities. The archive accomplishes this task by taking ownership of the records, ensuring that they are understandable to the accessing community, and managing them so as to preserve their information content and authenticity. The major focus for preserving archival information has been to ensure that they are stored using media with long-term stability and that access to these media is carefully controlled. Archiving encompasses the activities that prolong the usable life of archival records by minimizing the physical and chemical deterioration of records and preventing the loss of informational content.

8.14   A census operation generates a tremendous amount of information, including in print and digital formats. The purpose of archiving, in the context of censuses, is to ensure that the records of census operation (deemed important for maintaining an accurate historical account of the census operation as well as for enabling the reconstruction of census processes) are appropriately preserved in the long term so they will be available for future use.

8.15   It is important to establish institutional-level guidelines for archiving statistical collections. The standards and policies to be included in the guidelines for administering and maintaining the census archive system should include:

(a) Storage management policies for both digital and paper archival content, including, in the case of digital content, migration policies to ensure that archive storage formats do not become obsolete;

(b) Format standards, documentation standards and the procedures to be followed for managing access control and maintaining confidentiality;

(c) Emergency preparedness and disaster recovery policies to limit damage from disasters or other emergencies;

(d) Security policies for the contents of the archive to prevent accidental or malicious loss, including from human errors.

8.16   Policies to be instituted should include those for emergency preparedness and disaster recovery. Emergency preparedness aims to limit damage from disasters or other emergencies. When damage occurs, good emergency response and recovery practices help to save more records in usable condition. Emergency preparedness minimizes damage from any emergency, whether a small-scale building problem or a catastrophic natural disaster. When an emergency does occur, effective response and recovery actions are necessary to salvage

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[124] *Reference Model for an Open Archival Information System (OAIS), Recommended Practice*, CCSDS 650.0-M-2 (Magenta Book), issue 2, June 2012.

and preserve as many records as possible. The disaster recovery policies should provide mechanisms for duplicating the digital contents of the archive collection and, for example, storing the duplicate in a physically separate facility. This function is normally accomplished by copying the archive contents to some form of removable storage media (such as digital linear tape or CD-ROM), but may also be performed via hardware transport or network data transfers. The archive should have a formal succession and contingency plans in place in case the archive ceases to operate or the governing or funding institution substantially changes its scope.

8.17   In the case of digital content, making backups of files is also an essential element of data management and disaster recovery policy. Regular backups protect against accidental or malicious data loss and can be used to restore originals if there is loss of data. Accidental or malicious loss of data can be caused by:

(a)   Hardware faults or failure;

(b)   Software or media faults;

(c) Virus infection or malicious hacking;

(d)   Power failure;

(e) Human errors, for example, changing or deleting files.

Choosing a precise backup procedure to adopt depends on local circumstances, the perceived value of the data and the levels of risk considered appropriate for the circumstances.

8.18   It is important to develop and maintain an inventory of data and documents for preservation. Examples of important data and documentation to retain include:

(a) Data files and description of variables;

(b) Census maps and questionnaire images;

(c) Planning and design decisions concerning census phases, including preparatory activities and overarching processes such as quality management;

(d) Dissemination plans and strategies;

(e) Field test design and results;

(f) Questionnaire design, cognitive or usability testing results;

(g) Instructions to respondents and interviewers;

(h) Description of the data collection and data-processing methodologies;

(i) Description of the imputation and data-editing methodologies;

(j) Specifications and computer code (for example, specifications and code for sampling, editing, weighting, imputation, analysis, variance estimation and tabulation);

(k) Description of models used for estimates;

(l) Description of data confidentiality and disclosure avoidance techniques;

(m) Quality measures, including the methodology and interpretations of the measures;

(n) Evaluation reports, including special evaluations such as non-response and user satisfaction;

(o) Publicly available documentation associated with the release of data.

1.   Archiving individual records

8.19   The focus of the following elaboration of archiving is on census individual records irrespective of the format – paper questionnaires or electronic records.

8.20   The essential purpose of archiving individual census records is to keep them safe for future use, primarily in the domain of genealogical research and longitudinal social and anthropological studies, as well as for use by historians, demographers and social scientists.[125] The release of archived individual census records is subject to the passage of time as per the census legislation. The defined period usually encompasses many decades, thus ensuring that the use of individual information will not endanger the confidentiality and the privacy of the respondents.

8.21   Individual census records refer either to census paper questionnaires (where these were used for collecting information from the population) or to the digital records on each enumerated person and household (if the data collection did not involve paper questionnaires), including their direct identifiers, such as name, address and so forth. In the case of bimodal or multimodal data collection, that is, a combination of paper and non-paper questionnaires, as in the case of using Internet forms and mail-out/mail-back paper questionnaires, the resulting collection of individual records would also be a combination of paper and digital recordings.

8.22   In the case of digital records. the accompanying documentation becomes an indispensable part of the archiving process. As a number of variables in the digital record are presented as codes, it is necessary to archive all the codebooks and all the other documentation, such as the data collection instrument, that are needed for fully unlocking the value of each of the variables in the record. While this accompanying documentation is also valuable in the case of archiving paper questionnaires, these are by nature visual, thus requiring only reading skills and the knowledge of the language initially used for completing them to grasp the content, as long as they are in good physical shape.

8.23   Consequently, the importance of providing detailed guidance on the process of archiving individual census records (or any images of them) in the census legislation cannot be overstated. These provisions provide the legal basis for maintaining the archives and procedures related to the release of archived records. The time lag between the data collection and the release of the archived records needs to be clearly indicated – for example, it is 72

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[125] In some countries, archived individual records have been used for other purposes, such as for identifying membership in aboriginal communities and for claiming pensions and social services.

years in the United States of America and 92 years in Canada. In some cases, the original questionnaires are only temporarily stored before being fully disposed of, as in India, one year before the next census takes place. Table 31 gives information on the length of time completed census returns or lined databases are kept after the census in the ECE region.[126]

Table 31

Length of time for retention of census returns

	Total countries	
Length of time (on the basis of census legislation)	**Number (*n* = 49)**	**Per cent**
Kept only for as long as they are required for data processing, then destroyed	11	22
Destroyed 1–5 years after census	12	24
Destroyed 6–10 years after census	6	12
Destroyed after 20 years	4	8
Made open to the public after 30–50 years	1	2
Made open to the public after 51–75 years	1	2
Made open to the public after 76–100 years	5	10
Made open to the public after 100 years	3	6
No decision yet on length of time	6	12

1.1   Procedures for archiving individual records

8.24   Archiving a vast amount of records represents a considerable challenge in all circumstances. In the case of individual census records it may be compounded by the sheer number and format. However, in all cases the national statistical authority[127] needs to develop an institutional strategy for archiving, on the basis of three components: organizational infrastructure, technological infrastructure and resources.

(a)   Organizational infrastructure

8.25   The organizational infrastructure refers to the arrangements that need to be put in place within the national statistical office to ensure the efficiency of the archiving and eventual retrieval process. In most cases a centralized unit within the office is put in charge of

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[126] *Measuring Population and Housing: Practices of ECE Countries in the 2010 Round of Censuses*, Economic Commission for Europe, Geneva, 2014, table 6.8.

[127] In some countries (for example, the United States), the function of archiving individual census records is administered by other public agencies, such as the national archives institution.

the archiving, maintenance, secure storage and eventual release of individual records. Once the time lapse mandated by law for the release of records expires, the actual release to the public is usually implemented by dispatching relevant batches to the libraries covering parts of the country to which the records refer and to a central national library.

(b) Technological infrastructure

8.26   This refers to the actual technology used for archiving. In contemporary circumstances, storing huge numbers of paper questionnaires is not usually cost-effective, as it requires a significant physically secure structure, regulated temperature and humidity, and a host of other requirements, including protection from fire hazards, floods and extreme weather events. Consequently, in most cases the actual questionnaires are scanned and images of them stored in various electronic storage devices. As an example, the individual census schedules from the 1940 population and housing census of the United States are available from a website in the form of scanned images.[128]

8.27   The technological infrastructure does not refer only to the actual technology used in the archiving process – it also consists of a series of protocols for archiving and establishing cross-references that enable successful retrieval of records. In the example of the 1940 United States census, all the records were archived on the basis of the enumeration district, as the first-level threshold, then county, then district and so forth. Therefore, the technology should be built around a well-developed archiving scheme that enables efficient identification and retrieval of the records.

8.28   In the case of archiving digital records, contemporary technology provides a vast array of possible solutions. However, it also requires a well-designed archiving scheme that ensures efficient storage and retrieval, as well as access to the accompanying metadata and documentation.

(c) Resources

8.29   Resources for archiving need to be taken into account at the early stages of planning for the census, in the context of the technological and organizational infrastructure. In assessing the amount of funds required it is necessary to adopt a strategic, long-term approach. This is because the archiving, maintenance and release of records will essentially constitute a perpetual activity – as long as censuses are part of the national statistical system, there will always be a need to prepare either for the release of the next round of records or for archiving the newly acquired one.

1.2 *Archiving individual records and microdata*

8.30   Individual census records as described above for archiving purposes differ from the census microdata in a most significant manner: they retain the direct identifiers – name, address, enumeration area – as these very identifiers represent the essential information for

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[128] See, for example, http://1940census.archives.gov/.

genealogical, anthropological, historical and longitudinal social studies. In the case of microdata, these identifiers would be removed, as well as any other characteristics that can directly or indirectly identify the respondent. Microdata are defined as electronic records pertaining to each unit of observation; in the case of the population and housing censuses, this would refer to individuals, housing units and households. This information is stored in variables. Variables can be of different types (for example, numerical or alphanumerical, discrete or continuous). They can be obtained directly from the respondent via a questionnaire or by observation or measurement (for example, by GPS positioning), or imputed or calculated.[129]

8.31   It is expected that anonymized microdata will become a standard feature of census data dissemination in the 2020 round of population and housing censuses. Consequently, chapter VI, section E, subsection 3.3, of the present handbook presents a comprehensive elaboration of principles and protocols for the dissemination of microdata files.

2.   Preservation of paper documents

8.32   The vast majority of physical records in census archives consist of paper files, volumes, maps, plans and reports. Paper-based materials can deteriorate chemically and physically. Some deteriorate because of their inherent properties, others as a result of poor storage or display conditions. Damage can be caused by poor handling practices. The media on paper-based objects, such as ink, watercolour or pencil, can also degrade. While deterioration cannot be stopped entirely, measures can be taken to influence the rate at which it happens.

8.33   Physical preservation measures that can be taken to preserve paper documents include the following.

(a) Careful handling is the essential basic strategy for the long-term preservation of paper files.

(b) Simple archival enclosures such as boxes, folders, wallets and paper cards protect paper-based items against mechanical damage, light and dust. They also provide micro-environments that reduce temperature and relative humidity fluctuations.

(c) Before placing files in protective packaging it is important to ensure that they are free of dust, are unaffected by mould or insects, and are not actively deteriorating.

(d) The way in which files and general papers are arranged in boxes is very important. Storage shelves and cupboards should be designed and set out to minimize damage to any stored items. Properly cured powder-coated metal shelves should be used for paper records, and plan cabinets for flat storage of maps, plans and large artworks.

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[129] Olivier Dupriez and Ernie Boyko, *Dissemination of Microdata Files: Principles, Procedures and Practices*, IHSN Working Paper No. 005, August 2010.

(e) Storage drawers should be clearly labelled with their contents so that items may be retrieved with a minimum of handling.

(f) Paper documents should be stored in optimum environmental conditions for storage of all types of archival materials. If air conditioning operates, avoid wide fluctuations in conditions as this can physically stress records and accelerate their deterioration.

(g) Keep the storage area clean and dust free to reduce the chance that pests will be attracted to record storage areas for food and shelter.

(h) Photocopying is often used to preserve a copy of the information on a fragile or deteriorating record, as an access copy to preserve a heavily used original record, or to exhibit a copy and preserve the original record in storage.

(i) Digital file scanning can be used to produce high-resolution digital files that are required for preservation and access.

2.1   Facility for storage

8.34   The storage and preservation of physical records is a key element in the archiving programme. Census agencies should develop a comprehensive storage plan covering all types of records and their storage locations and ensure that appropriate arrangements for storage have been made to ensure the security, maintenance and accessibility of the records.

8.35   Areas and rooms designated for storage of digital or non-digital archival holdings should be suitable for the purpose for which they are being used. The environmental parameters should be tightly controlled to reduce vulnerability of archival content and media of storage. Archival content should be well organized, clearly labelled, easily located and physically accessible. For this purpose, it is important to establish standards for structural and environmental control, fire safety, preservation, and security for archival storage conditions and facilities. The standards should be developed taking into account national building codes and other relevant regulations as well as financial resources available for the purpose. If the storage facilities cannot be brought into conformity with every standard, mitigating measures need to be taken to minimize threats to the archival holdings. Some standards to consider include the following.

(a) **General structural standards.** The facility must be designed in accordance with applicable building codes to prevent building collapse or failure, and constructed with non-combustible materials and building elements.

(b) **Protection against water damage.** The facility must be sited away from flood zones, the roof membrane must not permit water to penetrate the roof, and piping must be located to avoid leakage into the storage area.

(c) **General heating, ventilation and air-conditioning requirements.** The heating, ventilation and air-conditioning system must provide sufficient air exchange to maintain requirements for temperature, relative humidity and pollutant control.

(d) **Finishing materials.** Only permitted paints should be used on walls, ceilings and shelves.

(e) **Requirements for lighting.** Ultraviolet radiation must be avoided.

(f) **General fire safety requirements.** Facilities must comply with fire safety requirements.

(g) **Smoke detection and automatic sprinkler system.** The archival facility must have an approved, supervised, automatic smoke detection and automatic sprinkler system.

(h) **Security (physical, network, computer system) requirements.** The facility must comply with minimum security specifications to prevent unauthorized access, changes to data, disclosure of data or destruction of data.

2.2   Digitization of paper documents for electronic access

8.36   Transforming paper documents (such as forms, reports, maps, drawings or correspondence), photographs, or microforms into digitally stored electronic images offers census agencies several immediate benefits, including greatly reduced record-handling costs and improved operational efficiency. Traditional paper-based records and storage and retrieval systems are often labour-intensive, time-consuming processes. Since original source documents can deteriorate (or even disappear) when used for reference, in many cases it is prudent to convert them to another form or medium that can provide equal or greater utility without harming the originals. Digital imaging technology can be used to convert and store electronic images of documents on optical digital data disks and automatically retrieve the information to a display screen or printer for reference. Due to the vast data storage capacities they offer, optical digital data disks are often integral components of digital imaging systems. The linkage of digital imaging, which generates sizeable electronic files, to the superior storage capacity of optical digital data disks has made both types of technology increasingly attractive to those seeking improved staff productivity and enhanced user services.

8.37   The decision to digitize and build an image record system using optical digital data disks should be based on a thorough analysis of the census agency's immediate and long-term information-processing requirements. The adoption of digital imaging and optical digital data disks is not without perils, owing to the many challenges resulting from a rapid technological evolution. Maintaining long-term access to, or usability of, digital imaging data requires ensuring the following.

(a)   **Data readability.** Typically, issues of non-readability involve some aspect of an older storage device that makes it physically incompatible with existing equipment. This hardware obsolescence occurs when storage devices and media used today become incompatible with those developed in the future.

(b) **Data retrievability.** Data readability refers to the ability to process the information on a computer system or device other than the one that initially created the digital information or on which it is currently stored. Data retrievability, which assumes

readability as just defined, means that identifiable records or parts of records can be selected and accessed.

(c) **Data intelligibility.** Data intelligibility means that the information a computer retrieves is comprehensible to another computer system or a human viewer.

8.38   The management policy issues that census agencies must take into account include (a) the trade-off between the costs and benefits of the digital imaging and optical digital data storage technology for a more effective delivery of service; (b) disposition of original records converted to a digital format and stored on digital optical media; and (c) planning for technical issues such as selection of a systems architecture (preferably, an open-source environment that supports the integration of standardized system components and is not reliant on proprietary hardware and software components) and development and integration of the digital imaging and optical digital data storage system.

8.39   When the decision is taken to digitize a paper collection, a set of guidelines needs to be created in order to maintain consistency and quality through the whole process, as digitization can be time consuming and more than one staff member may undertake the work. One important consideration is whether the files resulting from the digitization process should be simply stored as images (for example, a TIFF image of the paper) or whether they should be converted to fully searchable text (that is, OCR is performed). Due to the complex nature of qualitative data collections, which can include printed paper questionnaires and schedules with typed and handwritten comments, some materials may not be suited to OCR and the option of rekeying may be considered.

D.   Digital preservation

8.40   Preserving information in digital forms is much more difficult than preserving information in forms such as paper and film.[130] Along with the many advantages in terms of, for example, searchability and replication, the spread of digital technology in every field brings certain disadvantages. The rapid obsolescence of digital technology creates considerable technical dangers, in particular a much greater risk than in the past of losing the possibility of restoring, rendering or interpreting the information. Ways of avoiding or reducing these technical dangers will need to be detailed in the plan for preservation. There are also organizational, legal, industrial, scientific and cultural issues to be considered. To ignore the problems raised by preserving information in digital forms would lead inevitably to the loss of this information.

8.41   Planning for census archiving entails developing plans for the preservation of digital information stored in the archival system so that it remains accessible to, and understandable by, the user community over the long term, even if the original computing environment

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[130] The text of the section on the preservation of digital records was prepared on the basis of *Reference Model for an Open Archival Information System (OAIS), Recommended Practice*, CCSDS 650.0-M-2 (Magenta Book), issue 2, June 2012.

becomes obsolete. Preservation planning functions include evaluating the contents of the archive and periodically recommending archival information updates, recommending the migration of current archive holdings, developing recommendations for archive standards and policies, providing periodic risk analysis reports, and monitoring changes in the technology environment and in the user community's service requirements. Preservation planning also develops detailed migration plans, software prototypes and test plans to enable implementation of migration goals.

8.42   It is essential for an archive to have documented policies and procedures for preserving its digital information content. The preservation strategies and procedures should be developed taking into account the following.

   (a) **Requirements and emerging standards.**

   (b) **Risks facing the archival system.** Risk management is a suitable methodology to provide balance between needs and means, and between immediate activity imperatives and long-term objectives of the preservation mission. Risk management can also provide useful metrics to quantify elements that are usually difficult to estimate in the decision-making process. This function provides periodic risk analysis reports to the administration addressing expected risks and their possible mitigation on the basis of current and proposed updates, operating policies, procedures and standards.

   (c) **Input from the user community.** Users should be engaged to be sure the information content is still understandable to them, including through, for example, a periodic review with participants representing the user community.

   (d) **Monitoring of technology.** Monitoring technology is a crucial function for tracking emerging digital technology, information standards and computing platforms (hardware and software) to identify technology that could cause obsolescence in the computing environment of the archive and prevent access to some of its current holdings.

8.43   The preservation policies should include a long-term technology usage plan, updated as technology evolves, which is essential to avoid being caught with very costly system maintenance, emergency system replacements, and costly data representation transformations. They should also include a migration plan consisting of detailed migration plans, prototype and test plans, user community review plans and implementation plans.

E.   Digital migration

8.44   The rapid pace of technology and the fast-changing nature of electronic data storage media present a challenge to the preservation of information over a long period of time. No matter how well an archival system maintains its current holdings, it will eventually need to migrate many of its holdings to a different hardware or software environment to keep them

accessible. Today's digital data storage media can typically be kept at most a few decades before the probability of irreversible loss of data becomes too high to ignore.

8.45   The challenge of information preservation in the face of changing technology and user requirements compels digital migration. Digital migration is defined as the transfer of digital information with the intention of preserving it. Broadly, there are three major factors that necessitate digital migration, as follows.

(a) **Improved cost-effectiveness.** The rapid pace of hardware and software evolution provides greatly increased storage capacities and transfer bandwidths at reducing costs. It also drives the obsolescence of some media types well before they have time to decay. To remain cost-effective, an archival system must take advantage of these types of technology. Depending on the particular types involved, the information may have to be moved to new media types not previously supported.

(b) **Media decay.** Digital media, over time, become increasingly unreliable. Even those that are used with some level of error correction eventually need to be replaced. The net result of media decay is that information must be moved to newer media.

(c) **New user requirements.** Users experience the benefits of new technology and consequently raise their expectations of the types and levels of service they expect from an archival system. In addition, archival systems may need to provide different levels of access performance to meet user demands over time.

8.46   Digital migrations are time consuming, costly, and expose the archival system to greatly increased probabilities of information loss. Another issue to consider with respect to digital migration of an archival system in the face of changing technology is the preservation of access and use. In some cases the data access supporting software tools and mechanisms may remain adequate for an extended period or can be reimplemented in the new environment. In some situations, it may be difficult or impossible to continue to use the same data access supporting tools and mechanisms and new tools suited to the new operating environment will need to be developed.