
Preliminary Report on Methodology Options for the 2016 Census

**Prepared by Don Royce
for the 2016 Census Strategy
Census Management Office**

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The conclusions and opinions expressed in this paper are those of the author, and do not necessarily reflect those of Statistics Canada.

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Executive summary

As part of the 2016 Census Strategy Project, I was retained by Statistics Canada in January 2011 to perform an initial assessment of methodology options for the 2016 Census of Population. This report presents the results of this initial assessment, which was completed in June 2011. It is intended to serve, along with the results of other work at Statistics Canada, as a basis for a more detailed assessment of options, to be completed by Statistics Canada by December 2011.

The assessment began with a wide-ranging review of census-taking approaches in countries around the world. It also considered international principles and recommendations for censuses of population and housing, in particular those from the United Nations, the United Nations Economic Commission for Europe, and the Conference of European Statisticians (Canada is a member of all three organizations). International census-taking approaches were then classified into four basic types: the traditional census, a census based on existing administrative registers (with or without additional data collection), the traditional census with yearly updates of characteristics, and the so-called 'rolling' census. The latter two approaches involve some form of continuous measurement, in addition to or in place of a census taken at a specific point in time.

The necessary conditions for using each approach and the main strengths and weaknesses of each approach were identified and documented. The use of these methods internationally in the 2010 census round was examined, and 11 case studies representing the approaches of 14 different countries were developed to gain a better appreciation of the potential applicability of each census-taking approach in Canada. This was followed by an assessment of the extent to which Canada currently meets the necessary conditions for each approach and, where it does not, what the experience of other countries can tell us about the necessary steps and the likely time frame for these conditions to become a reality.

As a result of this assessment, it is my conclusion that the only possible option for the 2016 Census is some variant of the traditional census approach. In the case of a census based on administrative registers, none of the necessary conditions are currently met. In particular, Canada has neither a Central Population Register nor a universal Personal Identification Number (PIN) that could be used to link such a population register (even if it existed) to other registers. Even in those countries that do have population registers and PINs, it generally takes several decades for such an approach to be implemented. In the case of approaches involving continuous measurement, for small-area data to be released in the same time frame as the 2016 Census or the National Household Survey (NHS), data collection would have to start in 2012, which is not possible. Continuous measurement might be a possible approach for the 2021 or later censuses, but further user consultation, research and testing would be needed to determine whether it would have any advantages over the current approach of a census taken every five years.

Within the traditional census category, a key unknown at this point is the accuracy of the data from the 2011 NHS, as well as the NHS' collection costs. Until further information becomes available later in 2011, it is recommended that the boundary between what census content should be mandatory and what content should be voluntary be left open.

Another key consideration in developing the options for 2016 is the appropriate balance between collecting some content from all households and other content from only a sample of households.

Based on these two considerations (mandatory or voluntary, 100% or sample), it is recommended that the potential options for 2016 be based on the possible combinations of the three following types of data content (building blocks):

- content that is required by legislation or that is otherwise sufficiently important that it must be collected on a mandatory basis from 100% of the population
- content that is required by legislation or that is sufficiently important that it must be collected on a mandatory basis, but only for a sample of the population
- content that can be collected on a voluntary basis and only for a sample of the population.

The first type of content would be part of any option that could be considered for the 2016 Census; consequently there are four possible options, depending on the presence or absence of the second and third building blocks. Three of these four options correspond to approaches that have been used in the past (including 2011); only the approach that would include all three building blocks has not.

Other considerations for 2016 that should be considered for further assessment and possibly pre-2016 testing include sample design considerations, the potential for closer integration of data collection for mandatory and voluntary questions, and the expanded use of administrative data within the traditional census approach.

Finally, the study identified three potential approaches for the 2021 Census or beyond. These are a census based on a new Central Population Register created by the federal government, together with the creation of a universal PIN; an approach whereby the 2016 Census would be kept up to date through a combination of existing administrative records and surveys; and some form of continuous measurement approach. The report outlines the issues that would have to be addressed for any of these approaches to be pursued. Considerably more work would be needed to develop and assess these approaches in detail before decisions about the census methodology for 2021 and beyond could be taken.

1. Introduction

Canada's Census of Population is the largest and most important statistical data collection operation of Statistics Canada. Conducted every five years, the census provides population and dwelling counts for Canada, the provinces and territories, and smaller geographic units such as cities and districts within cities. The census program, which in 2011 consisted of the Census of Population and the National Household Survey (NHS), also provides a wide range of information about Canada's demographic, social and economic characteristics. Results are used in determining the number of seats in Parliament, to delineate electoral boundaries, to calculate billions of dollars of transfers between levels of government, and for policy development, program and service delivery, and planning by all levels of government, by the private sector and by community organizations. The census is also the benchmark for other statistical programs such as the Population Estimates Program and the Labour Force Survey, and is an important source of data for the System of National Accounts.

Because of its magnitude, the planning and consultations for the census program must begin several years before the actual census date. The major changes introduced for the 2011 Census, in particular the introduction of the voluntary NHS as a replacement for the previously mandatory census long form, have made early planning for 2016 even more important. Accordingly, Statistics Canada launched the planning for 2016 with the establishment of the 2016 Census Strategy Project in December 2010.

The objective of the 2016 Census Strategy Project is to deliver options and ultimately a detailed recommendation on the methodology for the 2016 Census of Population to the federal government (Statistics Canada 2011a). A content determination framework and criteria for inclusion of content in the 2016 Census will also be provided.

I was retained by Statistics Canada in January 2011 to perform an initial assessment of methodology options for the 2016 Census of Population. This report presents the results of my assessment, which was completed in June 2011. In addition, the report provides an overview of potential methodology approaches for censuses further in the future (2021 and beyond). The primary audiences for the report were Statistics Canada senior management, the subcommittee of the National Statistics Council struck specifically to provide independent advice with regard to the 2016 Census, and the Expert Panel Review Committee that will act as an external review body for the findings of the 2016 Census Strategy Project.

The report addresses only the methodology component of the 2016 Census planning; separate exercises are underway at Statistics Canada on constitutional and statutory requirements, census content determination frameworks, and other aspects of the Canadian context. Along with the results of these other exercises, this present report is intended to serve as an input to a more detailed assessment of methodology options for the 2016 Census, to be completed by Statistics Canada by December 2011.

The remainder of this report is structured as follows:

Section 2 provides an overview of the study, including a description of the information sources that were used and of the international census-taking approaches that were examined.

Section 3 describes each of the census methodology approaches in detail, including the necessary conditions for using the approach and its main strengths and weaknesses.

Section 4 of the report presents a statistical overview of the census methodology approaches being used by other countries for the 2010 round of censuses, and describes general trends in census-taking methodologies since 2000. Section 4 also provides a set of case studies that describe recent census developments and planning efforts in selected countries.

Section 5 provides the initial assessment of the various census methodology approaches in the Canadian context, based on the answers to the following questions:

1. To what extent do the necessary conditions for using the approach exist at present in Canada?
2. If the necessary conditions do not exist, what does the experience of other countries tell us about the steps required to create those conditions and the likely time frame for them to become a reality?

Section 6 presents the recommended options to be retained for further review for the 2016 Census. An option is recommended for retention if the necessary conditions either exist or could exist by 2016.

Section 7 presents considerations for the further investigation and assessment of census methodology approaches which, while they are not feasible for the 2016 Census, could be potential approaches for the 2021 Census or beyond.

Section 8 concludes with a brief description of the next steps for Statistics Canada to develop the options and recommendations for the methodology of the 2016 Census.

2. Overview of the study

The study consisted of five steps:

Step 1

The first step was to compile and review a large number of existing sources of information on census-taking methods in other countries. These sources included several international organizations, including the United Nations Statistics Division (UNSD), the United Nations Economic Commission for Europe (UNECE), and the related Conference of European Statisticians (CES). In addition, a review was conducted of documentation available from numerous national statistics institutes, including the United States (U.S.) Census Bureau, the United Kingdom (U.K.) Office for National Statistics, the Institut national de la statistique et des études économiques (France), the Swiss Federal Statistical Office, Statistics New Zealand and many others.

One of the most relevant sources of information on international census-taking methods was the UNECE. The UNECE is one of five regional commissions of the United Nations (UN)¹ and currently has 56 member countries, including Canada, the United States, and some countries from Asia. Other non-member countries, such as Australia, often participate in its work. Sources of information from the other four regional commissions were also examined, but very little additional information of relevance was found. Because of their comparable levels of social and economic development, as well as the maturity of their statistical systems, the member states of the UNECE, supplemented by Australia and New Zealand, provide by far the best comparison group.

1. The other four regional commissions are the Economic and Social Commission for Asia and the Pacific (ESCAP), the Economic Commission for Latin America and the Caribbean (ECLAC), the Economic Commission for Africa (ECA) and the Economic and Social Commission for Western Asia (ESCWA).

Step 2

In the second step, internationally recognized principles and recommendations for census-taking were taken into account. In this regard, the fundamental document is *Principles and Recommendations for Population and Housing Censuses, Revision 2* (United Nations 2008). This document is intended for use by all member states of the UN in planning the 2010 round of censuses. It describes principles and makes recommendations concerning operational aspects of population and housing censuses, the topics to be included in population and housing censuses, and census products and data utilization. In parallel with the development of the UN document, the UNECE, in cooperation with the Statistical Office of the European Communities (EUROSTAT), produced the document *Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing* (UNECE 2006). The UNECE document makes recommendations for countries within the UNECE region in the areas of census methodology, technology, and population and housing topics.

The UN defines a population census as "...the total process of collecting, compiling, evaluating, analysing and publishing or otherwise disseminating demographic, economic and social data pertaining, at a specified time, to all persons in a country or in a well-delimited part of a country" (United Nations 2008, page 7). A similar definition is provided for a housing census, pertaining "...to all living quarters and occupants thereof..." In the remainder of this document, the terms 'census' or 'census of population' will mean both a population and a housing census.

The UN identifies four essential features of population and housing censuses (Ibid., page 8):

1. **Individual enumeration** – Each individual and each set of living quarters is enumerated separately and the characteristics thereof are recorded separately. Only in this way can the data on the various characteristics be cross-classified. This requirement can be met by collection of information in the field, by the use of information contained in appropriate administrative registers, or by combinations of these methods.
2. **Universality within a defined territory** – The census should cover a precisely defined territory, for example, the entire country or a well-delimited part of it. Every person present or residing in the territory and every set of living quarters irrespective of type should be included. This does not preclude the use of sampling techniques for obtaining data on specified characteristics. Such universality provides the basis for producing data for small geographic areas and small subgroups of the population.
3. **Simultaneity** – Each person and each set of living quarters should be enumerated at the same well-defined point in time, and the data collected should refer to a well-defined reference period. This does not preclude the possibility of having different reference periods for different data items (for example, employment status may refer to the week prior to Census Day while income may refer to the previous calendar year).
4. **Defined periodicity** – Censuses should be taken at regular intervals so that comparable information is made available in a fixed sequence. The UN recommends that a national census be taken at least every 10 years, and notes that national and international comparisons are of greater value when countries undertake a census in years ending in '0' or at a time as close as possible to this, although it recognizes that national factors such as legal, administrative, financial and other considerations should take precedence in fixing a census date.

To this list the UNECE adds a fifth feature (UNECE 2006, page 8).

5. **Small-area data** – The census should produce data on the number and characteristics of the population and living quarters related to the smallest geographic areas of the country, and to small population groups of interest, consistent with protecting individual confidentiality.

Step 3

In the third step, on the basis of the literature review, the variety of census-taking approaches was classified as follows:²

1. Traditional census
2. Census employing existing administrative registers:
 - (a) Register plus complete enumeration
 - (b) Register plus survey collection
 - (c) Register plus complete enumeration plus survey collection
 - (d) Register-based only census
3. Traditional census with yearly updates of characteristics
4. Rolling census

Within each of these approaches, there exists a wide variety of more specific methodologies. For example, with any of the approaches involving collection of census or survey information directly from respondents (all except 2.(d)), the data may be collected by enumerators or through self-completion of a questionnaire by the household. Questionnaires may be mailed out using an address list compiled in advance or dropped off by enumerators as they travel through their designated enumeration areas. The questionnaire may be in either paper or electronic form and various response modes may be used, such as mail-back, pick-up, telephone and Internet.

The various approaches involving administrative registers can range from all of the census data being produced from registers to only basic data being produced from registers, with the rest produced from complete enumerations and/or sample surveys, either ad hoc or pre-existing. At a minimum, however, methods 2.(a) to 2.(d) refer to an approach where at least the basic population and dwelling counts are produced from administrative registers.

Step 4

In the fourth step, an initial assessment was conducted on the applicability of each approach in the Canadian context, based on the questions listed in Section 1. This assessment resulted in the recommendation to eliminate some of the options from further consideration for the 2016 Census.

Step 5

In the final step, recommended options to be retained for the 2016 Census were developed, as well as considerations for investigating and assessing approaches for future censuses (2021 and beyond).

2. This is a slight reorganization of the classification used in UNECE (2006), with the addition of method 2.(c).

Some important points should be kept in mind when reading the remainder of the report:

- Each country has its own unique conditions for census-taking, including its legislative and administrative environment, its history with census-taking and government data collection generally, its specific information needs, and its financial resources. By classifying the wide variety of census-taking methods into a small number of basic methods, there is some risk that details that are important in a particular country context may be obscured. Nevertheless, basing the discussion of methods on the options listed above was found to be a useful approach.
- It is as yet unknown exactly how the new 2011 Census and NHS approach will affect the possible options for conducting the 2016 Census. In particular, there is a scarcity of information or experience internationally on conducting a census where part or all of it is voluntary. The only known experience appears to be a 2003 test of a voluntary American Community Survey in the United States, and census questions on religion, which are optional in some countries.
- This report addresses census methodology at a high level, and is not concerned with specific census technologies for data collection, data capture, data processing or dissemination. For example, it does not cover subjects such as questionnaire design, data collection by Internet or hand-held devices, data capture via optical character recognition, new edit and imputation methods, and record linkage methods. Instead, the census methodologies discussed in this report are concerned with the fundamental approach to producing data on the population and housing stock of Canada.
- It is assumed in this report that the 2016 Census program will be national in scope and that the content that is required in Canada in 2016 is similar to that collected in the recent past by the census or, for 2011, by the combination of the 2011 Census and the NHS.
- The UN, the UNECE and the CES have not yet developed their principles and recommendations for the 2020 round of censuses. While Statistics Canada is well represented in these bodies and continues to keep abreast of developments in other countries and international organizations, the international principles and recommendations referred to in this report largely pertain to the 2010 round of censuses.

3. Census-taking approaches

This section describes each of the census-taking approaches and the necessary conditions for its use. The main strengths and weaknesses of each approach are also described, taking into account factors such as adherence to the five essential UN/UNECE features, costs, response burden, implications for census content, frequency and timeliness of data, data accuracy, and risks particular to the approach.³

3.1 Traditional census

3.1.1 Description

With the traditional census approach, census population and housing data pertaining to a specific point in time (i.e., a 'Census Day') are obtained from a complete enumeration⁴ of the population and housing

3. The material in this section is based in large part on UNECE (2006), Appendix II.

4. It is universally recognized that no enumeration will ever be 100% complete, but this is the goal.

units. The data may be collected by enumerators or through self-completion of a questionnaire by the household. Various collection modes may be used, such as personal visits, mail, telephone and Internet. One questionnaire may be used to collect the data from all households, or a long questionnaire may be completed by a sample (generally very large) of households, with the remainder of households receiving only a short questionnaire. The traditional census is ideally conducted at regular intervals, such as every 5 or 10 years, to facilitate comparisons over time. The traditional census is the approach used by the majority of countries in the world and in the UNECE region.

3.1.2 Necessary conditions

For a traditional census to be successfully used, the following conditions must exist:

- There must be a high level of awareness and cooperation by the public to participate in the census.
- There must be a geographic infrastructure for the census, such as a set of maps (if questionnaires are distributed by or completed by enumerators) and/or a list of addresses (if questionnaires are mailed out), that permits the geocoding of all questionnaires to very small geographic areas.
- There must be a stable political and socially secure environment in the country, both to encourage public participation and to provide safe conditions for enumerators.
- If self-completion is used, there must be a relatively high level of literacy in the population.
- The country must have the legal and administrative framework and the resources, both human and financial, to undertake a traditional census.

3.1.3 Strengths

The traditional census has the following main strengths:

- It fulfils all five of the UN/UNECE features of a census: individual enumeration, universality, simultaneity, defined periodicity and production of small-area data.
- From a data user perspective, the traditional census provides a snapshot of the entire country at one point in time and provides data for small areas and subgroups of the population that may be available from no other source.
- The choice of content of the traditional census is relatively flexible. It is normally based on a balance of the statistical needs of users, costs, data quality and the intrusiveness/burden on respondents.
- Widespread public participation generates interest in seeing the results, contributing to the usefulness of the census and statistics more generally.
- The traditional census can be used to identify small subgroups of the population to be followed up with more detailed post-censal surveys.

3.1.4 Weaknesses

The traditional census has the following weaknesses:

- Because it requires the individual enumeration of every housing unit and person in the country, a traditional census is relatively expensive.
- The costs and complexity of a traditional census mean that it can only be conducted every 5 or 10 years. As a result, some of the data may become out of date before the next census is conducted.
- The large volume of data to be collected, captured and processed usually means that several months elapse from Census Day to the dissemination of the results.

- The traditional census imposes some amount of burden on the population. There may also be duplication of reporting if some of the information has already been reported to the government.
- Because a high level of public participation is required, with the associated high visibility, the traditional census is subject to changing public and government attitudes about the trade-offs among data requirements, quality, costs and intrusiveness/burden issues. It can also become the focus of protests that have little to do with the data collection itself.
- Funding is concentrated in the one- or two-year period around the census year rather than being spread evenly.
- The traditional census is subject to unforeseen events (e.g., natural disasters, labour disruptions and elections) that can seriously affect the census and, in some cases, limit the possibility to recover.

3.2 Census employing existing administrative registers

3.2.1 Description

With the register-based approach, census data are produced by linking together existing administrative data sources such as population registers, business registers, building/dwelling registers, employment registers, education registers and taxation registers. To date, such register-based censuses have been conducted primarily in the Nordic countries, although an increasing number of countries (mostly in Europe, see Section 4.1) are moving to the use of registers for conducting at least a portion of their censuses in the 2010 round. A few countries base their entire census on registers, while other countries generate some of the data from registers (e.g., population counts and basic demographic data) and produce the rest of the required data from a complete enumeration of the population and/or sample surveys. Because all such variants use administrative registers as the basis of the census, they have similar necessary conditions, strengths and weaknesses.

3.2.2 Necessary conditions

Several conditions are necessary for the adoption of a register-based approach (Tønder 2008, UNECE 2007, and Redfern 1989).

- There must be a legal basis giving the statistical agency the right to access administrative data at the unit level and to use identification numbers to link various administrative data sources together for statistical purposes. The legislation must also provide a detailed definition of data protection; for example, it should specify that the statistical data produced by the linkage process may not be fed back to the administrative databases (known as the 'one-way traffic' principle.)
- There must be public understanding and approval of the use of administrative data for statistical purposes and public recognition of the advantages of using data already collected for administrative purposes compared to collecting the data again.
- There must be a universal Personal Identification Number (PIN) that can be used to link administrative data across sources at the unit level. In the Nordic countries where register-based censuses are most developed, the PIN is used for virtually all transactions with the government, at both the national and local levels (e.g., driver's license, employment, school enrolment and health care).

- The country must have a well-developed set of register systems that fulfil administrative needs but that also contain data covering the most important subject areas for the statistical system. At a minimum there must be a population register, a business register, and a building/dwelling register. The coverage of these registers and the quality of the data contained within them must be sufficiently high to be useful for statistical purposes.
- There must be incentives, such as a legal requirement, for the population to register and to inform the register authorities of changes of address. There must also be a reliable way to assign the units included in the registers (e.g., persons, businesses, dwellings) to a detailed geographic level (geocoding) in order to produce small-area detail.
- Dates of changes or events (e.g., change of address, change of employers, births, deaths, immigration and emigration) must be reliably recorded with minimal delay in recording the event.

3.2.3 Strengths

The register-based approach has the following main strengths:

- Like the traditional census, the register-based census can fulfil all five of the UN/UNECE features of a census: individual enumeration, universality, simultaneity, defined periodicity and the production of data for small areas and subgroups, although the extent to which it does so may depend on the specific registers that are used.
- Like the traditional census, the register-based census can provide a snapshot of the entire country at one point in time and can provide data for small areas and subgroups of the population.
- Because it uses data already collected for administrative purposes, the marginal costs to produce census data from registers are generally much less than for a traditional census.⁵
- A register-based census can generally produce data on a yearly basis, compared to every 5 or 10 years for a traditional census.
- The data may be available just a few months after the reference date (the exact timeliness will depend on how quickly the registers are updated).
- A register-based census reduces the burden on respondents, because it reuses data that have already been collected for other purposes.
- Funding can be more evenly spread than for the traditional census conducted only every 5 or 10 years.
- A register-based census is less susceptible to unforeseen events, since it is based on administrative registers instead of large field collection operations.
- The register-based census may be used to identify small subgroups for post-censal surveys, depending on the variables contained in the registers.

5. A UNECE survey conducted in June 2009 found that, among the five European countries that are conducting a register-based only census in the 2010 round, the per capita cost ranges from \$0.03 for Denmark to \$1.3 for Austria, compared to \$20.1 for Canada (UNECE 2010a). This cost advantage diminishes considerably when a register-based census is combined with enumeration and/or surveys, but can still exist. The median cost is \$6.8 per capita for a combined census compared to a median cost of \$8.2 for the traditional census. (All figures are in purchasing power parity U.S. dollars.)

3.2.4 Weaknesses

The register-based census has the following main weaknesses:

- The census content is limited to the data variables already available in the administrative registers. This restriction can be eased by combining a register-based census with a complete enumeration and/or sample surveys (either ad hoc or pre-existing) to produce content that is not available in the administrative registers, although at increased costs and respondent burden.
- The concepts and definitions that apply to data in the registers may not correspond to those desired for statistical purposes.
- Linkage of different administrative registers for the same unit may result in data inconsistencies that need to be resolved.
- The register-based census is subject to changes in legislation and administrative practices on the part of the register authorities.
- Development of a register-based census is generally a long process, taking several years or even decades, with a significant front-end investment, and possibly requiring negotiated agreements across multiple levels of government.

3.3 Traditional census with yearly updates of characteristics

3.3.1 Description

As the name suggests, the traditional census with yearly updates of characteristics consists of two parts. A traditional census is conducted periodically to collect basic information (e.g., population and dwelling counts, age and sex), and a large-scale sample survey collects the more detailed population and housing information on a continuous basis. To date the only country using this method is the United States.⁶ The American Community Survey consists of a sample of 250,000 households each month and asks the questions that were previously on the long form of the Decennial Census. As with the traditional census, various modes of data collection are possible for both the periodic census and the continuous survey.

Because data collection for the survey portion is continuous rather than at a single point in time, the data must be pooled over time to produce estimates. In the case of the American Community Survey, the estimates represent averages for one-, three- and five-year periods. The length of the time period depends on the size of the geographic area; estimates for large areas such as states or large cities may be one-year averages, while for small municipalities, counties or census tracts they may be three- or five-year averages. Because the estimates do not refer to a fixed point in time, the interpretation and analysis of these time-period averages can be somewhat complex. Once the survey is established, however, updated results can be produced each year for all geographic areas by replacing the earliest year of data with the most recent year.

6. A more detailed description of the U.S. methodology is given in Section 4.2.10.

3.3.2 Necessary conditions

The traditional census with yearly updates of characteristics approach requires the following conditions to be met:

- It generally requires a multi-year program of comprehensive planning, development and testing to implement.
- It requires the agreement of census stakeholders and policy-makers to move from a once-every-5- or 10-year snapshot to an annually updated multi-year average approach.
- A geographic infrastructure (address list or maps) is required, but unlike the traditional census, the infrastructure must be continuously updated rather than being updated once just before the census.
- Several years of data collection (three or five) are required before the first data for smaller areas can be made available.
- It requires substantial annual funding rather than funding clustered in a one- or two-year period around census year.
- Because it is more complex, both in terms of its operations and the resulting data, it requires a high level of professional staff to maintain it and users with the ability to interpret the data.

3.3.3 Strengths

The traditional census with yearly updates of characteristics approach has the following strengths:

- The traditional census part of the approach meets all of the UN and UNECE features of a census, although only for the basic data.
- From a data user perspective, the traditional census part provides a snapshot of the entire country and for small areas and subgroups of the population, although only for the basic data.
- The content has the same degree of flexibility as a traditional census and, in theory, can incorporate new data needs relatively quickly into the continuous survey part, although at the expense of temporarily reduced comparability for smaller geographic areas that rely on aggregated averages over a period of three to five years.
- Once established, the continuous survey part of the method produces updated data every year.
- Funding is more evenly spread out over the census period rather than being concentrated.
- The smaller scale of the continuous survey coupled with a more permanent field staff permits tighter control over non-sampling errors.
- Improvements to the methodology of the continuous survey can, in theory, be made relatively quickly, although at the expense of temporarily reduced comparability for smaller geographic areas that rely on aggregated averages over a period of three to five years.
- The reduction of the traditional census part of the method to a basic census allows concentration of efforts on the most important aspects of the census (e.g., population counts).
- The continuous survey part of the method reduces the operational risks, as there is an opportunity to recover from unforeseen events.

3.3.4 Weaknesses

The main weaknesses of the traditional census with yearly updates of characteristics approach are:

- The continuous survey part of the approach does not respect the UN's simultaneity feature of a census because data must be accumulated over time. The resulting data represent time-period averages rather than a point-in-time 'snapshot,' and may thus be more difficult to interpret and to compare to other data.
- Both the traditional census and the continuous survey impose some amount of burden on the population. There is also a small amount of duplication at the time the traditional census is conducted because respondents in the continuous survey are also asked to respond to some of the same questions on the census. There may also be duplication of reporting if some of the information has already been reported to the government.
- Although new estimates can be produced annually, multi-year averages do not represent completely new data. For smaller areas, the 'average age' of the data may be substantial. For example, the United States published its first five-year estimates in December 2010, based on data collected from January 2005 to December 2009. From the average date of the data collection period (i.e., July 2007) to the publication date (December 2010) is approximately three and a half years.
- Compared to the data from a long questionnaire collected as part of a traditional census, where the short-form data can be used to calibrate the long-form data, the precision of the continuous sample survey will be lower for the same sample size (the sampling error will be higher).

3.4 Rolling census

3.4.1 Description

The rolling census also uses a continuous sample survey, but instead of conducting a periodic traditional census, the continuous sample survey is designed so that it covers 100% of the country over some time period (e.g., five years). To date, the only country using a rolling census is France.⁷ Many of the necessary conditions, strengths and weaknesses are similar to those of the traditional census with yearly updates of characteristics. As with the traditional census conducted at a point in time, a variety of collection methods can be used, including long and short forms, canvasser or self-enumeration methods, and various response modes.

Because data collection is continuous rather than at a single point in time, data from the rolling census must be pooled over time. In the case of the French rolling census, complex mathematical methods involving calibration and interpolation are used to transform data collected over a five-year period into estimates with a single reference date. However, once the rolling census is established, updated estimates can be produced each year by replacing the earliest year of data with the most recent year.

3.4.2 Necessary conditions

The rolling census approach requires the following conditions to be met:

- It generally requires a multi-year program of comprehensive planning, development and testing to implement.

7. A more detailed description of the methodology of France's approach is given in Section 4.2.11.

- It requires the agreement of census stakeholders and policy-makers to move from a once-every-5- or 10-year snapshot to an annually updated multi-year approach.
- A geographic infrastructure (address list or maps) is required, but unlike the traditional census, the infrastructure must be continuously updated rather than being updated just once before the census.
- Several years of data collection (five in the case of France) are required before the first data for smaller areas can be made available.
- It requires substantial annual funding rather than funding clustered in a one- or two-year period around census year.
- Because it is more complex, both in terms of its operations and the resulting data, it requires a high level of professional staff to maintain it and users with the ability to interpret the data.

3.4.3 Strengths

The rolling census approach has the following strengths:

- The content has the same degree of flexibility as a traditional census. It is also quite flexible for being able to incorporate new data needs relatively quickly, though at the expense of temporarily reducing comparability of the data.
- Once established, the rolling census produces updated data every year.
- Funding is evenly spread out over the census period rather than being concentrated.
- Improvements to the methodology of the rolling census can, in theory, be made more frequently than once a decade, although at the potential expense of temporarily reducing comparability of the data.
- The rolling census approach reduces the operational risks of the census, as there is an opportunity to recover from unforeseen events.
- The smaller scale of the rolling census permits tighter control over non-sampling errors.

3.4.4 Weaknesses

The rolling census has the following weaknesses:

- In order for the rolling census approach to respect the UN/UNECE simultaneity feature of a census, complex estimation methods are needed. In the French implementation, mathematical techniques are used to transform data collected over a five-year period to a single reference date,⁸ and sampling is used to produce the official population estimates.⁹ The resulting estimates are not simply the results of an enumeration but incorporate a degree of modelling and sampling error.
- The rolling census imposes some amount of burden on the population. There may also be duplication of reporting if some of the information has already been reported to the government.
- Because of the rolling approach, persons who move may be enumerated more than once or may be missed. The effects of this may not cancel out, particularly for small areas.
- Although data are produced more frequently (annually), the interval from the reference date of the data to the publication date may still be substantial. For example, France published its first five-year estimates in December 2008 with a reference date of January 1, 2006, a lag of three years.

8. Unlike the United States, France does not publish averages over various time periods, but instead uses calibration and interpolation techniques to bring all of the data collected during a five-year period to a common reference date of January 1 of the middle year of the five-year period.

9. In municipalities with a population of over 10,000, 40% of the population is surveyed over a five-year period. This sample is then combined with a 100% register of dwellings using calibration techniques to produce population estimates.

4. Census methods used in other countries

4.1 Survey of census methods for the 2010 round of censuses

Each decade, the United Nations Statistics Division (UNSD) conducts a world-wide survey of country plans for the next round of censuses. For the 2010 census round, the UNSD conducted the survey in June 2009 and published the results in February 2011 (United Nations 2011b).

Of the 233 countries that were sent a questionnaire, 138 countries (59%) responded. There was considerable regional variation in response rates, with response rates exceeding 75% in Asia, Europe and Northern America, but only reaching 20% in Oceania. Table 1 presents a summary of the results for the questions on the census methods used.¹⁰

Table 1 Number of responding countries by main census methodology and additional sources for census data in the 2010 census round

Main census methodology ¹¹	Number of responding countries	Number of countries reporting using additional sources	Additional sources for census data ¹²		
			Annual or regular sample survey	Ad hoc sample survey conducted specifically for the census	Administrative register(s)
All countries	138	49	18	16	24
Traditional census	115	31	12	8	17
Administrative register(s)	15	10	6	4	0
Rolling census	1	1	0	0	1
Other	7	7	0	4	6

Source: United Nations, United Nations Statistics Division, 2011.

Of the 138 countries that responded to the survey, 115 (83%) use the traditional census as the main source of data to produce their population count, 15 countries (11%) use administrative registers as the main source, 1 country (France) uses a rolling census, and 7 countries (5%) use other methods. These 'other' countries are primarily countries where administrative registers are used for some census activities, but are not used as the main source of census data. Of the 15 countries using administrative registers as the main source of census data, 12 are in Europe, 2 (Bahrain and Singapore) are in Asia and 1 (Greenland) is in Northern America.

10. Of the 95 countries that did not respond, virtually all of them are likely to use the traditional census method.

11. Defined as the main source of data used for the total population count.

12. A country may use more than one additional source for census data, thus the sum of the figures under 'Additional sources for census data' may be higher than the 'Number of countries reporting using additional sources.'

In addition to the main census method, 49 of the 138 responding countries report using additional sources to provide data on specific census topics. Of the 115 countries that conduct a traditional census as the main method, 31 (27%) report using other sources of data, including 20 that use annual, regular or ad hoc sample surveys and 17 that use administrative registers. The latter could include, for example, obtaining data for some data topics from administrative sources, as Canada did for income data using tax files in the 2006 Census. Among the 15 countries that use administrative registers as the main source, 10 (67%) report using other sources, including 6 that use an annual or regular sample survey and 4 that use an ad hoc sample survey conducted specifically for the census. The other 5 countries, all of them in Europe, use administrative registers exclusively for their census.

For the UNECE region more specifically, 50 of the 56 countries responded to the survey, and more precise details are available on the methods that are used. Table 2 lists the UNECE countries that are using a traditional census, a register-based census combined with complete enumeration and/or surveys, a register-based only census, and other census methods for the 2010 round.¹³

Table 2 Census types for 50 of 56 UNECE countries in the 2010 census round

Census type			
Traditional (28)	Combined (15)	Register-based only (5)	Other (2)
Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Cyprus, Georgia, Greece, Hungary, Ireland, Kazakhstan, Kyrgyzstan, Luxembourg, Malta, Montenegro, Portugal, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Tajikistan, the former Yugoslav Republic of Macedonia, Ukraine, United Kingdom	<p>Register + enumeration: Czech Republic, Estonia, Italy, Latvia, Lithuania, Spain</p> <p>Register + survey: Belgium, Iceland, Israel, Netherlands, Slovenia, Switzerland, Turkey</p> <p>Register + enumeration + survey: Germany, Poland</p>	Austria, Denmark, Finland Norway, Sweden	<p>Rolling census: France</p> <p>Traditional census with yearly updates of characteristics: United States</p>

Source: United Nations Economic Commission for Europe, Conference of European Statisticians, 2010.

Two other non-UNECE countries to which Canada is often compared are Australia and New Zealand; both are using the traditional census method for their 2011 Censuses.¹⁴

13. Data in Table 2 and Table 3 are drawn from UNECE (2010a), which classifies countries by 'Census type' rather than by 'Main census methodology' (Table 1, from United Nations 2011b). The seven countries that Table 1 classifies as 'Other' (Estonia, Israel, Italy, Latvia, Lithuania, Poland and Turkey), plus the Czech Republic (classified as 'Traditional census' in Table 1), are classified as 'Combined' in Table 2.

14. On February 25, 2011, New Zealand announced that the 2011 Census was cancelled due to the Christchurch earthquake. On May 27, 2011, New Zealand announced that the census will be held in March 2013.

While the traditional census remains the predominant method for the 2010 round, there is a definite shift in the UNECE region towards using registers in census-taking. Table 3 shows the number of countries by census type in the 2000 and 2010 rounds.

Table 3 Number of UNECE countries by census type in 2000 and 2010 rounds

Census type		2010 round				
		Traditional	Combined	Register-based only	Other	Total
2000 round	Traditional	27	7	1	2	37
	Combined	0	6	0	0	6
	Register-based only	0	0	3	0	3
	No census	1	2	1	0	4
	Total	28	15	5	2	50

Source: United Nations Economic Commission for Europe, Conference of European Statisticians, 2010.

Of the 37 countries that conducted a traditional census in 2000, 7 countries (Czech Republic, Estonia, Israel, Italy, Lithuania, Poland and Turkey) now plan to use administrative registers in combination with complete enumeration and/or surveys. One country (Austria) is planning to move to a register-based only census, and 2 countries (France and the United States) are now using other methods.

Of the 6 countries that used a combined approach and the 3 countries that used a register-based only census in 2000, all of them plan to use the same approach in the 2010 round.

Finally, of the 4 countries that did not conduct a census in the 2000 round, Bosnia and Herzegovina is planning to conduct a traditional census; Germany and Iceland are planning to conduct combined censuses; and Sweden is planning to conduct a register-based only census.

4.2 Experiences of selected countries

Section 4.1 provided a statistical overview of the census-taking methods being used both worldwide and in the UNECE region in the 2010 census round, as well as general trends in the UNECE region since 2000. In the course of the literature review, documents describing the experiences of specific countries in planning for their 2010 Census or beyond were also examined. This section summarizes the experiences of selected countries that are contemplating major changes for the future (United Kingdom, New Zealand, Australia and India) or that have made major changes for their recent censuses, either by employing administrative registers (Nordic countries, Netherlands, Germany, Switzerland and Austria) or by adopting a continuous survey collection approach (United States and France).

The descriptions that follow are not intended to cover all of the possible variations in census-taking methodologies or to imply that there is nothing to be learned from countries not described. Rather, the goal is to illustrate the major features of census-taking approaches as applied in practice, as context for the assessment to follow in Section 5.

4.2.1 United Kingdom

The United Kingdom has carried out a traditional census every 10 years since 1801. Census Day in 2011 was March 27.

In October 2003, the Office for National Statistics (ONS) published a discussion paper entitled *Proposals for an Integrated Population Statistics System* (ONS 2003a). The discussion paper was accompanied by several supporting papers on related topics, including linkage of existing data sources (ONS 2003b), the use of the rolling census approach (ONS 2003c) and a review of international approaches (ONS 2003d). The main drivers behind the proposals were increasing non-response rates with the traditional approach and the increasing costs associated with this trend, as well as the need for more frequent and timely data for small areas and subgroups.

The proposals identified five key areas of work that would have to be brought together (ONS 2003a, page 6):

- the creation of a high-quality address register
- the registrar general's feasibility study into the development of a population register
- administrative data linkage
- the 2011 Census
- forming a continuous population survey from the existing range of public household surveys.

The hope was that the new Integrated Population Statistics System (IPSS) would be in place by 2013, replacing the traditional census. Comments were solicited on the proposal, and the results were published by ONS in 2005 (ONS 2005a). The ONS summarized the comments received as follows:

In general, users generally expressed strong support for the overall proposals for an integrated population statistics system (IPSS), which were described as exciting and visionary. However, nearly all the comments emphasised what a massive undertaking it would be, and a common concern amongst users was that the strategy was high risk and that the proposals did not perhaps fully recognise the risks. Nevertheless, the feeling was that the vision was worth striving for.

The feasibility study into the creation of a national population register was an ONS-led effort known as the Citizen Information Project (CIP). In April 2006, the CIP was folded into the National Identity Register, which was the database underlying the *Identity Cards Act 2006*. The Act and its associated U.K. National Identity Card subsequently became controversial, especially following the October 2007 loss of some 25 million records of child benefit recipients. In January 2011, the Conservative-Liberal Democrat Coalition government repealed the *Identity Cards Act 2006*, and all records in the National Identity Register were to be destroyed by February 2011.¹⁵

In April 2009, the ONS commissioned survey research into the public's views on data sharing between government departments and the creation of a single central database to hold basic personal information (ONS 2009). In response to a question on the creation of a single central database, 64% of respondents were supportive, 13% neither supported nor opposed the idea, 18% were opposed and 5% didn't know.

15. "ID cards go up in flames in first step to tackle 'database state'." *The Independent* (London, United Kingdom). February 10, 2011. p. 6.

The ONS is now looking at options beyond its 2011 Census (UNECE 2010b). The ONS has identified three broad categories of options: a point-in-time census providing a population 'spine,' administrative data as the basis for population estimates, or a survey or rolling census approach. These are very similar to the approaches considered in this paper. The ONS expects that it will complete its work on 2021 options development in 2014, and stresses that "...the work on alternative options does not imply a decision on a traditional 2021 Census."

4.2.2 New Zealand

New Zealand has a statistical system very similar to that of Canada, although its population is considerably smaller. Like Canada, New Zealand conducts a mandatory census every five years to provide population counts and socioeconomic data, and to serve as the basis for other statistical programs. The 2011 New Zealand Census was to consist of a dwelling form containing 22 questions and an individual form containing 48 questions. Sampling is not used (i.e., there is no 'short' form).

Statistics New Zealand has examined the feasibility of moving to a population register-based approach for future censuses (Bycroft 2010). The main driver was the escalating costs of conducting a census; response burden is not considered a major issue in New Zealand.

The study concluded that New Zealand currently meets none of the conditions¹⁶ for introducing a register-based census. The legislative framework, while it partially meets the requirements for using administrative registers, would require changes to privacy legislation to permit the long-term retention of unique identifiers and data linkage on a regular rather than case-by-case basis. Second, there has been no public discussion of the rationale and benefits of using registers. The paper describes the cultural aspects of this debate, citing the public arguments in the United Kingdom concerning the introduction of the U.K. National Identity Card. Third, New Zealand has no common unique identifier in use across administrative systems that could be used to link data sources, and in fact, such an identifier is expressly forbidden by the *Privacy Act*. Finally, there is currently no population register in New Zealand.

The paper concludes that the creation of a population register would have to be a long-term government initiative, and that two or three censuses would likely elapse before it could be used. While it did not carry out a formal comparison of the costs of conducting the census to the costs of establishing and maintaining a population register, it does state that there would also have to be strong administrative purposes to be served, and that countries with population registers "...see major benefits for government administration and efficiency, and in having a rigorous system for personal identification." Public acceptability would be a key factor, as would the quality of the population register and other data that could be linked.

4.2.3 Australia

Like New Zealand and Canada, Australia conducts a mandatory census every five years. The 2011 Australian Census will be held on August 9. For 2011, as for 2006, the census questionnaire contains a total of 60 questions, covering both dwelling and person characteristics. All households are required to fill out the same questionnaire (i.e., there is no 'short' form).

16. New Zealand also used the necessary conditions described in Tønder (2008) and UNECE (2007) and listed in Section 3.2.2 of this report.

Australia is currently beginning to plan its 2016 Census, which will again be a traditional census. Because of increasing demands for new census content, the Australian Bureau of Statistics (ABS) is looking at ways of increasing the number of questions included on the census, but without increasing respondent burden. One proposal for 2016 (Bell and Whiting 2009) is to have three different versions of the census questionnaire. All three versions would have the same 50 'core' questions, but each version would have a different set of 10 'thematic' questions. Each version of the questionnaire would go to one third of Australian households. An individual household would therefore only have to answer 60 questions, as in previous censuses, but data could be produced for a total of 80 questions—50 questions on a 100% basis and 30 questions on a 33% sample basis.

One disadvantage of the proposed method is that the thematic questions could only be cross-tabulated if they appear on the same version of the questionnaire. Because of this, the 30 questions would be divided into 3 themes of 10 questions each, with related questions that would naturally be cross-tabulated appearing in the same theme. As well, new methods of estimation would need to be developed.

At this juncture, the ABS has made no final decisions about the questions to be included or the methods to be used for the 2016 Australian Census. The ABS will begin conducting user consultations in 2012 to determine the 2016 Census content.

4.2.4 India

India conducted its first census in 1872, and since 1881, it has conducted a census every 10 years without interruption. The 2011 Census was the 15th in its history (Chandramouli 2009, 2010 and Government of India 2011). The legal basis for the census is *The Census Act, 1948* and *Census Rules, 1990*, which specify that response is compulsory and that all data are to be kept confidential. The 2011 Census was conducted using the face-to-face interview methodology, using paper forms printed in 16 different languages. It involved 2.5 million enumerators and supervisors.

The 2011 Census was conducted in two phases. Between April and September 2010, data collection for the Houselisting and Housing Census was carried out. The houselisting and housing schedule contained 35 questions, including the total number of persons in the household, name and sex of the household head, condition of the building, number of rooms, and various household facilities (e.g., latrine, telephone, and drinking water). The second phase was the population enumeration, conducted during a three-week period from February 9 to 28, 2011. The population form contained 29 questions for each person, covering basic demographic characteristics, mother tongue and other languages known, education, economic activity (e.g., employed, occupation), place of birth, travel to work, migration, fertility and mortality, religion and scheduled caste or tribe.

Following data collection, the paper forms were scanned and the information was extracted using intelligent character recognition software. Provisional results for the 2011 Census of India were released on March 31, 2011, and showed that the population was approximately 1.2 billion persons. Final 2011 Census results are expected in 2012.

At the same time as the 2010 data collection for the Houselisting and Housing Census took place, the first phase of data collection for a new National Population Register (NPR) was conducted.¹⁷ The NPR form was separate, and included 14 questions for each person: name of the person and resident status, name of the person as it should appear in the NPR, relationship to head, sex, date of birth, marital status, educational qualification, occupation/activity, names of father, mother and spouse, place of birth, nationality as declared, present address of usual residence, duration of stay at present address and permanent residential address. In a second phase of collection for the NPR, biometric data (photograph, fingerprints and possibly an iris scan) were collected for all usual residents of 15 years of age or more.

After several stages of validation and correction, the NPR data are forwarded to the Unique Identification Authority of India, who 'de-duplicates' the records using the biometric information and issues a unique 12-digit identification number for each person.¹⁸ The cleaned information is then returned to the Office of the Registrar General and Census Commissioner, India (ORG & CCI), and will be used to form the National Population Register. The information collected will be used by the ORG & CCI to issue national identity cards to the entire population on a phased basis over the next several years.

The main purpose of the NPR is to create a comprehensive database of all usual residents (as defined by a six-month residency rule), in order to better target government benefits and services, to improve planning and to strengthen security. The legal basis for the NPR and national identity cards is *The Citizenship Act, 1955*, and *The Citizenship (Registration of Citizens and Issue of National Identity Cards) Rules, 2003*.

The 2011 Census is expected to cost some 22 billion rupees (approximately \$481 million Canadian) and the creation of the NPR is expected to cost 37.6 billion rupees (approximately \$820 million Canadian). The potential role of the NPR in future Indian censuses has been raised, but at this point no decision has been taken for 2021. Among the issues that would need to be addressed are the content of the NPR versus that of the census (the census generates much more detail) and the confidentiality of the information (by its nature the NPR is not confidential). One possibility under consideration is to combine the NPR with a regular house-to-house census.

4.2.5 Nordic countries

The primary experience with register-based censuses is in the Nordic countries. Table 4 summarizes the experience of the four Nordic countries that plan to implement a totally register-based system by 2011 (reproduced from UNECE 2007, page 5). In some cases, the table reflects plans as of 2007, as indicated by dates in italics or with question marks.

17. The NPR collection was conducted one week later than the census to maintain some separation.

18. In the case of persons under 15 years of age, who do not have biometric information, the unique identification number is linked to the parent or guardian.

Table 4 Years of establishment of various registers and their use in producing census statistics

Type of register	Denmark		Finland		Norway		Sweden	
	Established	First used in census	Established	First used in census	Established	First used in census	Established	First used in census
Central Population Register	1968	1981	1969	1970	1964	1970	1967	1975
Business Register	1975	1981	1975	1980	1965	1980	1963	1975
Dwellings	1977	1981	1980	1985	2001	2011	2008?	2011?
Housing conditions	1977	1981	1980	1985	2001	2011	2008?	2011?
Education	1971	1981	1970	1975	1970	1980	1985	1990
Employment	1979	1981	1987	1990	1978	2001	1985	1985
Family	1968	1981	1978	1980	1964	1980	1960	1975
Household	1968	1981	1970	1975	2001	2011	2011?	2011?
Income	1970	1981	1969	1970	1967	1980	1968	1975
Totally register-based census		1981		1990		2011		2011?

Source: United Nations Economic Commission for Europe, 2007.

All four of the Nordic countries established Central Population Registers in the 1960s (1964 to 1969). Such registers evolved from local and national registers that in some cases date back several centuries. Three countries (Finland, Norway and Sweden) began using the Central Population Registers in their censuses of the 1970s, but it generally took several decades until these four countries were able to base their censuses totally on registers.

Denmark was the first country to adopt a register-only census approach. A Central Population Register, a Family Register and a Household Register were established in 1968, followed by the establishment of various other registers during the 1970s. All of these registers were used for the first time in a completely register-based census in 1981.

Finland was the next country to adopt a register-only census approach. It established a Central Population Register and an Income Register in 1969, and used these registers in its 1970 Census. Additional registers were established in the 1970s and 1980s, and the first register-only census was conducted in 1990.

Norway established its Central Population Register in 1964 and used it for the first time in its 1970 Census. It will conduct its first register-only census of population and housing in 2011, although it did conduct a register-only census of population in 2001, with additional field operations to collect information on housing and household membership, and to create a dwelling register.

Sweden established its Central Population Register in 1967 and used it for the first time in its 1975 Census. Although the Swedish Parliament passed legislation in 1995 mandating that the next census would be register-based only, it took until 2007 before the necessary legislation to construct a register of dwellings was passed (Axelson et al. 2010). Sweden will conduct a register-only census for the first time in 2011. It did not conduct a census in the 2000 round, although it did produce some of the data tables required by the European Union (EU) in 2001.

The experience of the Nordic countries suggests that once a Central Population Register is established, it can be used in the census within 5 to 10 years, but that the complete replacement of the census by registers takes much longer. In the case of these four countries, it has taken between 13 and 47 years from the time the Central Population Register is established to the complete changeover. The general pattern is that the Central Population Register is adopted first, and is initially supplemented by surveys or complete enumeration to collect information not available from the register. Then, as additional registers are developed and their quality becomes sufficient for census purposes, the collection of data is gradually replaced by administrative registers, until such time as field collection can be eliminated completely.

4.2.6 Netherlands

The first Dutch census was held in 1795, during a period when the country was a republic. After the Netherlands became a kingdom, censuses were conducted at approximately 10-year intervals, beginning in 1829. In 1859, the results of the Dutch census were used to set up municipal population registers, which were then maintained manually. For several censuses thereafter, the purpose of the census was twofold: to update and correct the municipal population registers, and to produce demographic and socioeconomic data on the population (Schulte Nordholt 2009).

The last traditional census in the Netherlands was conducted in 1971. Preparations for the 1981 Census showed a sharp decline in the willingness of the population to participate in the traditional census, resulting in a decision by the Dutch Parliament to postpone, and then eventually cancel, the 1981 Census. In 1991, the *Census Act* of the Netherlands was officially repealed (Bethlehem 2010).

However, due to its obligations to the EU, the Netherlands still had to conduct a census. For 1981, the census was replaced by tabulations from the central Population Register for demographic variables. The Population Register links the various municipal registers, which are kept up to date by the municipalities¹⁹ and maintained using common software approved by the national government. For socioeconomic variables, such as labour and education, census-type data were produced from the Labour Force Survey (LFS), whose sampling fraction was increased to 5% for this purpose. The same procedure was used in 1991, although the LFS sampling fraction was only 1%. Housing data were produced using the Housing Demand Survey 1989/1990. Both the 1981 and 1991 censuses were extremely limited in output; for example, no data were produced at the municipal level. As well, there were inconsistencies in the data produced from different sources.

For 2001, the increased demand for data by the EU and other international organizations, as well as improvements in the quality of several administrative registers, led to the development of the so-called 'Dutch Virtual Census.' Because the content of administrative registers is not as rich as in the four Nordic countries presented in Section 4.2.5, the Dutch Virtual Census is based on combining administrative registers with existing sample surveys.

19. Because government transfers to the municipalities are based on counts in the municipal population registers, there is a strong incentive for municipalities to keep them up to date.

Two important methodological developments were essential to the virtual census approach (Linder 2004). The first was the development of a Social Statistics Database (SSD), created by linking and integrating data at the micro-level from the central Population Register, from other administrative registers covering topics such as employment, benefits and income, and from sample surveys such as the 2000 and 2001 Labour Force Surveys and the Survey on Employment and Earnings to provide data on variables such as education and occupation. The Population Register serves as the 'backbone' of the SSD. For the administrative registers, records could be linked to the Population Register using the unique Social Security and Fiscal Number (replaced in 2007 by a Citizen Services Number²⁰). However, the sample surveys did not contain such an identifier; linkage was therefore done using date of birth, sex and address, occasionally resulting in some mismatches or non-matches. Once the data were linked at the micro level, the data were integrated by applying rules to resolve discrepancies.

The second major development was that of repeated weighting (Gouweleeuw and Hartgers 2004, Houbiers 2004). Variables that appeared on the registers were simply tabulated directly from the registers (i.e., they represented direct counts). However, for variables that appeared only on a sample survey, estimates were prepared using the technique of repeated weighting. This method ensures consistency of any new tables with all tables produced previously.²¹

A total of 40 tables were produced for the 2001 Census. Geographically, 28 tables were produced at the national level, 9 were produced at the 'COROP' (regional) level and 3 were produced at the municipal level. In terms of content, 8 tables covered housing, 2 covered commuting and 30 covered demographics (occupation, education, economic activity). Sub-city tables were produced for 10 large cities.

Statistics Netherlands has stated that the total cost of the 2001 Virtual Census was approximately 3 million euros (excluding the costs of the Population Register, which already existed), compared to an estimated cost of 300 million euros to conduct a traditional census. The approach also permitted faster production of results than those produced by other European countries using the traditional census approach.

Statistics Netherlands' plan for the 2011 Census is similar to that used in 2001. The SSD has continued to develop through the addition of sources such as a new Housing Register and the merger of other registers, and is now used to support a wide range of statistical production. Dutch legislation passed in November 2003 also provides Statistics Netherlands with increased authority to access administrative sources, at no charge. As well as using the SSD in the 2011 Census, the plan is to base all household statistics on the SSD by 2013. As well, the SSD serves as a valuable resource for methodological purposes, such as adjustment for survey non-response, which is relatively high in the Netherlands.

New European census legislation passed in 2008 mandates the production of census data on specific topics and at specific levels of detail that go beyond what was produced in 2001. As of 2009, Statistics Netherlands was examining whether the repeated weighting method will be able to meet these additional requirements in 2011.

20. To protect confidentiality, the linkage is actually done using a Record Identification Number (RIN) that has a one-to-one correspondence to the Citizen Services Number. A small unit within Statistics Netherlands is responsible for generating the RIN.

21. The technique is essentially a repeated application of the generalized regression estimator. Unlike a traditional weighting technique, where each record on the census database has a single weight that is used for all tabulations, the repeated weighting method generates a new set of weights for each new table. The new weights constrain the new estimates to be consistent with all previous tables.

4.2.7 Germany

City-level censuses in what is now Germany were held as early as 1471. Regular periodic censuses were carried out in the German Empire, first in 1871 and then every five years from 1875 to 1910. During and between the two world wars, censuses were held at irregular intervals, varying between one and eight years. In the postwar period, East Germany carried out censuses in 1950, 1964, 1971 and 1981, and West Germany held censuses in 1950, 1956, 1961, 1970 and 1987.

The last West German census was originally planned for 1980, but was postponed to 1983 and then to 1987 due to widespread public objections. As a result of legal cases brought against the government, changes to several aspects of the census were made by the Constitutional Court, and the modified census was eventually carried out in 1987. A concurrent census in East and West Germany was planned for 1991, but was cancelled with the fall of the Berlin Wall and reunification.

Since the last censuses in 1981 and 1987, official population figures have been based on intercensal population updates. However, the Federal Statistical Office believes that the official population of Germany is overestimated by about 1.3 million persons (out of approximately 80 million) because the basic data on which these estimates are based are seriously out of date (Federal Statistical Office 2011). As well, because the new EU census legislation requires that all member countries take censuses of population and housing every 10 years, Germany is conducting a 2011 Census, with a reference date of May 9.

Following methodological testing in 2001, the governing parties of the coalition government agreed in November 2005 to proceed with a 2011 Census, and on August 29, 2006, the federal cabinet decided that the 2011 Census would be register-based. On December 13, 2007 a census preparation law was enacted to enable preparations for the census to proceed, and on December 3, 2008 the *2011 Census Law* was enacted to provide the legal basis for conducting the 2011 Census. The law covers general policy, collection and consolidation of data, generation of households, organization, measures to assure the quality of the census results, the obligation to give information, data protection and final provisions (Gerull 2009).

The 2011 Census combines administrative registers, complete enumeration and sample surveys. The two main administrative sources are the municipal population registers, which contain comparable information from approximately 12,600 municipalities, and register information from the Federal Employment Agency. The latter contains information on employees subject to compulsory social insurance contributions, on persons who are registered as unemployed or looking for work, and on civil servants, army personnel and judges. Two versions of the municipal registers are obtained, one as of the census date and a second version at a later date with updates applied by the municipalities. Because there is no central population register and persons are sometimes registered in more than one municipality, a large matching operation is undertaken to attempt to eliminate duplicate registrations.

The administrative registers have several weaknesses for census-taking purposes that require them to be supplemented by both complete enumerations and sample surveys (Siedt 2006). First, coverage of the municipal population registers is known to be problematic for residents of institutions and collective dwellings. As well, the rates of undercoverage and overcoverage of the municipal population registers vary significantly by municipality size. For the registers from the Federal Employment Agency, some persons (e.g., the self-employed) are not well covered. Finally, some of the variables required by EU census legislation are not available in the registers, for example, details of employment, migration, and education and training.

The first complete enumeration is the Census of Buildings and Housing, conducted by mailing a questionnaire to all owners (not residents) of residential property. The enumeration is based on a nation-wide register of all buildings established specifically for the 2011 Census by the Federal Statistical Office and the statistical offices of the Länder, using sources such as files of land surveying offices, residents' registration offices and the Federal Employment Agency. The Census of Buildings and Housing questionnaire collects information such as the year of construction, type of building, equipment (e.g., bath or shower), floor space and number of rooms.

A complete enumeration is also conducted at residential establishments and collective living quarters, with the primary objective of addressing the weakness of the municipal population registers in covering these populations. For 'non-sensitive' residences (e.g., student residences, senior citizens' or care homes) the residents are interviewed in person. In 'sensitive' facilities (e.g., psychiatric hospitals and refugee establishments) only basic information, sufficient to establish the number of persons, is collected from the facility management.

The sample survey component will be conducted by personal interviews with a 10% sample of the population. Persons in non-sensitive residences are eligible to be included in the sample survey and the survey data will be collected at the same time as the enumeration of residential establishments and collective living quarters. The results of the survey will serve two purposes. First, they will be used to statistically adjust²² the municipal register counts for undercoverage and overcoverage to produce official population estimates. Second, the survey will produce data for required variables not available in the registers. A further 5% of the sample survey will be interviewed in a follow-up survey a few weeks later to measure the quality of the main sample survey.

In order to ensure high-quality data, responses to the complete enumerations and the sample surveys are compulsory. The final census results will be produced by linking these sources of data (i.e., registers, complete enumerations and sample surveys) together at the micro-data level. For example, household relationships will be established by linking the various components in a 'household generating procedure,' allowing the production of estimates such as the average floor space of families with three or more children.

The new German census approach of combining registers, complete enumerations and sample surveys is methodologically complex, but it is expected to be less expensive and to have reduced respondent burden compared to a traditional census. As this is the first time such an approach has been used in Germany, it is not yet known how successful it will be.

4.2.8 Switzerland

Switzerland has carried out a census almost every 10 years from 1850 to 2000. While previous Swiss censuses used administrative registers in a subsidiary role, Switzerland is making major changes for its 2010 Census (Federal Statistical Office 2008). The necessary legislation was adopted in June 2007, with an effective date of January 2008. The reference date of the 2010 Census was December 31, 2010.

22. In accordance with the 'one-way traffic' principle, the results of the sample survey, and of the matching of the municipal registers described earlier, are not fed back to the municipal registers. In other words, only the counts from the registers are adjusted, the registers themselves are not affected by the taking of the census.

The 2010 Swiss Census consists of four components.

The first component is an annual register survey that brings together data from the various municipal and canton-level population registers and data from the Federal Register of Buildings and Dwellings. The register survey will produce basic population, household and housing statistics on a census basis. To facilitate this new register survey, the new legislation mandated the following changes:

- harmonization of the municipal and canton-level population registers, in terms of their core variables, format, standards for completeness and accuracy, and protocols for electronic data exchange
- replacement of the existing social security number by a new 13-digit PIN issued to every Swiss resident and inclusion of the PIN on all registers
- assigning to each person in the population registers the nine-digit federal building identification number and, in addition, the three-digit dwelling identification number, so that household composition can be determined from the register
- linkage of persons in sample surveys to the person register by means of the PIN
- linkage of persons to the Business Register in order to link them to their employers.

The second component is an annual 'structural' survey of 200,000 persons of age 15 and over, or about 3.5% of this population. The content is similar to that of a typical census (e.g., employment, mobility, education, language, religion and culture, and family structure). Response to the annual structural survey is mandatory. Data from the survey can be pooled over several years to form time-period average estimates for small areas and subgroups, similar to the U.S. American Community Survey. Cantons and cities have the option to buy additional sample for their areas.

The third component is a series of topic-based telephone sample surveys of 10,000 to 40,000 persons, rotating among five topics (mobility, education, health, families, and language, religion and culture) over a five-year period. These surveys will provide data at the national level and for the seven regions of Switzerland.

The fourth component is an annual omnibus survey of 3,000 persons which will provide rapid answers to current questions. Results will be at the national level only.

The new 2010 Census is expected to provide more frequent and more highly integrated data at a lower cost, with reduced burden on municipalities, cantons and the population.

4.2.9 Austria

Austria is unique in moving from a completely traditional census in 2001 to a completely register-based census for 2011 (Lenk 2008, Fiedler et al. 2010). The legal basis for the new approach is the *Register-based Census Act*, passed in March 2006. A register-based census test was held in 2006 and the full census will be held in 2011.

The 2011 Austrian Census will be conducted by linking together eight existing 'base registers': the Housing Register of buildings and dwellings, the Central Population Register, the Register of Educational Attainment, the Register of enrolled pupils and students, the Central Social Security Register, the Tax Register, the Unemployment Register, and the Business Register of enterprises and their local units.

Unlike other countries that conduct a register-based census, the Austrian Data Protection Commission (DPC) does not permit the registers to be linked by a common PIN. Instead, the registers are linked by an artificial identifier, known as the 'branch-specific personal identification number for official statistics' (bPIN OS). This identifier is generated by the DPC from the PIN of the individual held on the Central Population Register, using a complex algorithm known only to the DPC. Statistics Austria then supplies the bPIN OS to the owners of the other registers in encrypted form, who return the data together with the encrypted bPIN OS and a number of their own. The latter can be used in case of follow-up questions by Statistics Austria.

One of the basic principles is that of redundancy. Because these registers were not connected in the past and each register collects its data independently, there are often data inconsistencies across registers that must be resolved. By matching a large number of registers, Statistics Austria hopes to determine the most 'plausible' value in the case of data inconsistencies. As well, to improve and verify the quality of the census results, the eight base registers will be linked to seven other 'comparison registers': the Child allowance register, the Central foreigner register, Registers of public servants of the federal state and the Länder, the Register of car owners, the Register of social welfare recipients, the Conscription Register, and the Register of alternative civilian service. The *Register-based Census Act* specifies which registers are base registers and which are comparison registers.

One of the main limitations of the new approach is that some of the data that were collected in previous censuses will no longer be available. In particular, the registers do not contain information on languages spoken, religion, mode and duration of commuting, and, most importantly, occupation. However, there have been some changes to the registers, such as the addition of the place of work to the social security records, to provide annual commuting data.

4.2.10 United States

The first U.S. Decennial Census was conducted in 1790. Sampling was introduced in the 1940 Census, when a long form was completed by 20% of households, with the rest receiving a shorter form than in previous censuses. In the 2000 Census, the long form was sent to approximately one in six households. For the 2010 Census, the long form was replaced by a large-scale continuous survey known as the American Community Survey (ACS).

The origins of the ACS date back to the early 1980s (U.S. Census Bureau 2009). In response to user demand for more timely data than the Decennial Census provided, continuous measurement was proposed as an alternative (Kish 1981). The U.S. Congress also recognized the need for more frequent data and authorized a mid-decade census for 1985, but the funds to conduct it were never allocated.

The idea of continuous measurement was resurrected again in the early 1990s, and in 1993, the U.S. Census Bureau developed a set of research proposals for an ACS. Three possible prototypes were outlined, and in 1994, one of the prototypes was chosen for further development. The survey would involve collection by mail, followed by telephone and then personal visit follow-up for non-response. Because the ACS was viewed as a replacement for the Decennial Census long form, response would be mandatory. In November 1995, testing of the ACS began in four counties, and was expanded to a further five counties in November 1996. Three additional counties were added in 1998, and in 1999, the test was expanded to 36 counties in 26 states. In 1999 and 2001, the test was expanded to cover Group Quarters (known as collective dwellings in Canada).

The primary purpose of the tests in the 1990s was to refine the methodology. Based on their success, it was decided to proceed, and in 2000, a large-scale demonstration ACS was introduced. The demonstration ACS included the original 36 counties and added 1,203 new ones (although the latter used an area sample design similar to that of the Current Population Survey) and had a total sample size of 866,000 households. The demonstration ACS had two purposes: first, to evaluate the feasibility of such a large-scale continuous survey from a methodological and operational perspective, and second, to compare the quality of the data from the demonstration ACS to that of the 2000 Census long form. The demonstration ACS was successful on both counts, and plans were developed for full implementation.

In 2003, at the request of the Congress, the Census Bureau conducted a test of making response to the ACS voluntary (U.S. Census Bureau 2003). The voluntary ACS resulted in more than a 20 percentage point drop in the mail cooperation rate and a reduction in the reliability of the data. The test also estimated that a voluntary approach would cost at least an additional \$59.2 million annually due to the increased telephone and personal visit non-response follow-up needed to obtain results of similar quality to a mandatory survey. The ACS has continued to be a mandatory survey.

The final phase of the ACS was its full implementation. Implementation was originally planned for 2003, but was delayed for two years due to budget restrictions. In January 2005, full implementation began in all 3,141 counties of the United States, with a sample size of three million households each year. After subsampling for non-response follow-up, responses are received from approximately two million households each year. Group Quarters were added to the full ACS in January 2006.

The first set of ACS one-year estimates was produced in 2006, three-year estimates were first produced in 2008, and five-year estimates were first produced in December 2010. The ACS estimates are calibrated to the intercensal population estimates at detailed levels of geography, rather than to the census counts as the long-form data were previously.

To date, the ACS has been considered a success, although a number of challenges remain for both the Census Bureau and data users (for example, see National Academies Press 2007). Throughout the development, testing, demonstration and implementation phases, the Census Bureau has worked closely with its data users, advisory groups, and other stakeholders to ensure that the new approach is understood.

The 2010 Decennial Census included only the basic demographic, race, Hispanic origin and housing questions, as previously asked on the short form. The Census Bureau's planning for the 2020 Census assumes that it will continue to be a short-form census. The main driver for planning the 2020 Census is the rising cost of the traditional census, which it attributes to declining self-response rates, paper-based and labour-intensive methods requiring a large field infrastructure, and substantial investments in updating the address frame (Weinberg 2010, Groves and Vitrano 2011). The Census Bureau has solicited ideas from a number of sources, including a panel convened by the National Academy of Sciences (National Academies Press 2010) and Statistics Canada; it has consolidated these ideas into some 75 possible research projects, and it has prepared a budget initiative for work to begin in October 2011. Current design alternatives range from simply enhancing the baseline census conducted in 2010 to an administrative record-based enumeration with field follow-up to fill data gaps. The Census Bureau will continue to seek input from stakeholders and the National Academy of Sciences as its plans for 2020 evolve.

4.2.11 France

Napoléon Bonaparte established the first traditional census in France in 1801. From then until the Second World War, the French census was conducted every five years, with a few exceptions. Following the Second World War, the census was conducted at irregular intervals: 1946, 1954, 1962, 1968, 1975, 1982, 1990 and 1999. The irregularity was in part because there was no legal requirement for a census to be taken in specific years.

In 1997, the Institut national de la statistique et des études économiques (INSEE) began looking at alternatives to the traditional census (Clanché 2010). One of the main drivers was the difficulty in securing budget for the census; the 1999 Census was originally supposed to have been conducted in 1997 but was delayed for budgetary reasons. Other factors were the increasing demands from users, particularly at the local level, for more regular and timely data, the difficulty in negotiating arrangements for the census with the local authorities ('communes') and the difficulties in controlling large-scale census operations involving the collection of data from 20 million households over a four-week period.

In February 2002, legislation was passed that paved the way for France to move to a rolling census for establishing, on an annual basis, the legal populations of its various administrative units, from the commune level up to the regional and national levels. After a period of user consultation, methodological development and testing, the rolling census was introduced in 2004 and its first set of official estimates based on five years of data collection (2004 to 2008) became available in December 2008. The rolling census is conducted in two different ways, depending on the size of the commune in which it is conducted.²³ Response to the census is required by law.

For communes with less than 10,000 residents, a complete census is conducted once every five years on a rotating basis. For example, a commune may receive the census in 2004, 2009, 2014, etc., while a neighbouring commune may receive the census in 2005, 2010, 2015, etc. The five panels of communes thus formed are 'balanced' on a number of characteristics from the 1999 Census so that each panel is as representative as possible at the region level.

For communes with a population of greater than 10,000 persons, an 8% sample of addresses is surveyed each year. The samples are chosen from an address register (*Répertoire d'immeubles localisés*) established from the 1999 Census, and kept up to date from administrative sources and with assistance from the local authorities. Thus, over a five-year period, some 40% of addresses are surveyed.

The 'legal population' for each geographic area is established annually, with a reference date of January 1 of the middle year of the previous five-year period. For example, the first set of estimates based on the 2004 to 2008 collection had a reference date of January 1, 2006. Because data collection is spread over the five year period and is conducted differently in large and small communes, complex mathematical adjustments, involving interpolation and calibration, are required to bring the data to the common reference date. For the large communes, the official population figures are established on the basis of a 40% sample, not a complete enumeration.²⁴

23. The description of the methodology provided here is a general overview; there are numerous exceptions and special cases. For full details, see Godinot (2005).

24. One hundred percent counts of addresses are available, and INSEE uses this information in its estimation procedures. Nevertheless, the official population figures are subject to sampling error.

Detailed socioeconomic data are disseminated a few months after the population figures. These data are also based on the previous five years of data collection, and are adjusted in order to maintain coherence with the population figures.

Responsibility for statistical data collection is much more decentralized in France than in Canada. While INSEE is responsible for establishing the protocols to be followed and the questionnaires to be used, and is the sole recipient of the confidential data, it is the local communes who are responsible for the actual data collection, i.e., hiring, supervising and paying enumerators, organizing field operations, etc. Questionnaires are dropped off by enumerators and collected by them on a return visit.

5. Assessment of census approaches in the Canadian context

Section 3 described the various census-taking approaches, the necessary conditions for each approach to be used and each approach's main strengths and weaknesses. Section 4 illustrated how these approaches are used internationally and described recent trends in census-taking.

This section of the report assesses each census-taking approach in the Canadian context, specifically looking at:

1. the extent to which the necessary conditions for using the approach exist at present in Canada
2. where the necessary conditions do not exist, what the experience of other countries tells us about the steps required to create those conditions and the likely time frame for them to become a reality.

For each census-taking approach, each of the necessary conditions is repeated, followed by an assessment of the current situation in Canada and the experience of other countries.

5.1 Traditional census

There must be a high level of awareness and cooperation by the public to participate in the census.

Canada:

Overall, public cooperation with the Canadian census has been excellent. For example, the response rate to the 2006 Census long-form questionnaire was 94%. While non-response rates have risen slightly during the past few censuses, they do not appear to have reached levels which bring into question the quality of the data.

In mid-2010, the government, citing privacy reasons, decided that the 2011 Census would consist of 10 questions, and asked Statistics Canada to provide options, from which the government chose one, for collecting the remaining proposed questions on a voluntary basis. The level of public cooperation with the voluntary NHS is as yet unknown but is expected to be lower than with the 2006 approach, when response was mandatory.²⁵

25. The planning assumption for the 2011 NHS, which replaces the census long form, is a 50% response rate; Statistics Canada hopes that the actual response rate will be higher.

Other countries:

Several countries have cited declining participation rates as a concern (e.g., ONS 2003a). In some European countries, response rates to surveys and censuses have fallen to levels much lower than in Canada, to the point where the traditional census had to be cancelled. For example, a pilot test for the cancelled 1981 Dutch Census estimated that the non-response rate would be 26% (Bethlehem 2010).

There must be a geographic infrastructure for the census, such as a set of maps (if questionnaires are distributed by or completed by enumerators) and/or a list of addresses (if questionnaires are mailed out), that permits the geocoding of all questionnaires to very small geographic areas.

Canada:

The Address Register (AR) was used to mail out invitation letters or questionnaires to approximately 80% of households in 2011. In the remainder of the country, questionnaires were dropped off by enumerators (18%), or the census was completed by the canvasser method (2%), using a well-developed set of maps. Coverage of the AR has increased since its first use for mail-out in the 2006 Census.

Other countries:

All countries that conduct a traditional census have geographic infrastructures consisting either of address lists, maps, or a combination of the two. (United Nations 2011b, Chapter 3).

There must be a stable political and socially secure environment in the country, both to encourage public participation and to provide safe conditions for enumerators.

Canada:

Canada has a very stable political and socially secure environment that supports both public participation and enumerator safety. There has never been an occasion where the census has had to be cancelled or postponed due to political instability or enumerator safety concerns.

Other countries:

Most developed countries are similar to Canada in terms of having conducted censuses on a regular basis. In less developed countries, particularly in Africa, censuses have occasionally been postponed for reasons of political instability (United Nations 2011b).

If self-completion is used, there must be a relatively high level of literacy in the population.

Canada:

Starting with the 1971 Census, self-completion has been the primary mode of enumeration in Canada. Compared to the canvasser (face-to-face) methodology, self-enumeration has important advantages in terms of privacy, costs and data accuracy. The addition of the Internet as a response option for the 2006 Census furthered these advantages.

For population groups where barriers of language or literacy do exist, the canvasser method is still used. The census questionnaire is translated into 20 ethnic and 11 aboriginal languages, as well as being available in braille, audio and signed video.

Other countries:

Self-enumeration tends to be used in developed countries for the reasons cited above, while face-to-face interviews are more common in less developed countries (e.g., India). Globally, the most common mode of enumeration is face-to-face interview, used by 85% of countries. Self-enumeration by paper questionnaires is the next most common mode (28% of countries), followed by Internet-based self-enumeration at 23% (United Nations 2011b, Table 4.1).²⁶

The country must have the legal and administrative framework and the resources, both human and financial, to undertake a traditional census.

Canada:

The requirement to conduct the decennial census in years ending in '1' is part of the *Constitution Act* and dates to 1870, the earliest of any country in the UNECE (UNECE 2008, Table 4.1). The quinquennial census, conducted in years ending in '6,' is required by the *Statistics Act* but is also a constitutional requirement, with the original obligation for quinquennial censuses recorded in the three acts that brought Manitoba, Saskatchewan and Alberta into Confederation.

Statistics Canada is charged with conducting the census and is allocated the financial resources to do so. Compared to other countries conducting a traditional census, particularly the United States, the costs per household in Canada have remained relatively stable over the past several censuses.

Other countries:

Most countries have either a census act or a statistics act as the legal basis for census-taking. For the 2000 census round in the UNECE region, all countries had one or the other and most countries had both (UNECE 2008, Table 4.1).

Globally, it is expected that 99% of the world's population will be counted in the 2010 census round.²⁷ The UN encourages all countries to conduct a census and provides extensive training and other forms of support (United Nations 2011a).

26. Figures add to more than 100% because many countries, including Canada, use more than one method.

27. This figure includes censuses of all types, not only traditional censuses.

Summary

The necessary conditions for the traditional census have existed since the first census was held in Canada in 1871. While cooperation with the census has declined slightly in the past decade, it is still at acceptably high levels.

The necessary conditions for the conduct of a traditional census are expected to exist for 2016, with two caveats. First, as of the writing of this report, the degree of public cooperation with the 2011 Census and NHS is unknown. A significant drop in response to either the census or the NHS could call the future of the 2011 approach into question. Second, the content of the census remains uncertain due to concerns about the mandatory nature of some of the census questions. The balance between relevance and privacy will need to be examined as part of the content determination framework.

5.2 Census employing existing administrative registers

There must be a legal basis giving the statistical agency the right to access administrative data at the unit level and to use identification numbers to link various administrative data sources together for statistical purposes.

Canada:

Section 13 of the *Statistics Act* gives Statistics Canada the right to access records held in any department or municipal office, corporation, business or organization for the purposes of the Act. However, in practice, Statistics Canada negotiates access to administrative data with each organization on a case-by-case basis. In many cases, other organizations are subject to laws that prohibit or limit the sharing of data under their control.

There is no explicit mention of record linkage in the *Statistics Act* itself. Statistics Canada's *Policy on record linkage* (Statistics Canada Policy Manual, 4.1) states that record linkage will only be undertaken when the public good clearly outweighs the potential invasion of privacy. All cases must be approved by the Chief Statistician and are posted on Statistics Canada's website.

In a situation where administrative registers would be combined with complete enumeration or survey collection, Statistics Canada's *Policy on informing survey respondents* (Statistics Canada Policy Manual, 1.1) would require that respondents be notified at the time of survey collection of any planned linkages of their survey responses to other data files, where linkage is for other than internal methodological purposes.

Other countries:

New census legislation may need to be introduced (e.g., Sweden, Netherlands, Switzerland, Austria) for countries to adopt a register-based approach involving access to and linkage of administrative registers. In the case of Sweden, more than 10 years was required for such legislation to become law; as a result, Sweden did not conduct a census in the 2000 round. In other cases (e.g., Switzerland, Austria), it was possible to adopt new legislation and put the new approach in place within a 10-year period.

All countries that conducted their census in the 2000 round using administrative registers (either combined or register-only) had data protection laws in addition to their census act or statistics act (UNECE 2008, Table 4.1).

There must be public understanding and approval of the use of administrative data for statistical purposes and public recognition of the advantages of using data already collected for administrative purposes compared to collecting the data again.

Canada:

There appears to be little or no research into Canadian attitudes toward the possibility of conducting a census using administrative registers. A partial indication may come from the 2006 Census, which gave respondents the option to allow Statistics Canada to obtain their income data from tax files, rather than completing the income questions on the census questionnaire. The national-level take-up rate for this option was approximately 82%.²⁸

In contrast was the public reaction in 2000 to the Longitudinal Labour Force File, created by Human Resources Development Canada (HRDC) in the 1990s as a research database intended to improve overall program efficiency. The file linked together personal tax records, child tax benefit records, the immigration and visitors file, provincial and municipal welfare files, and several others. The file was criticized by the Privacy Commissioner in his *1999-2000 Annual Report to Parliament* (Privacy Commissioner 2000) as a 'de facto citizen profile.' The subsequent negative public reaction led the government to destroy the file. However, it should be noted that the file was intended for research purposes rather than statistical purposes, and some of the Privacy Commissioner's concerns were about the lack of legal protection of the information in the file and the lack of transparency about the existence of the file.

Overall, the public acceptability of a register-based census is largely an unknown quantity, but it could reasonably be expected to be opposed by at least some members of the public.

Other countries:

The acceptance and use of population registers for administrative purposes is deep-rooted in many European countries, often dating back several decades or even centuries (Redfern 1989). Where such population registers already existed, the transition to using them for statistical purposes appears to have been a logical progression for both the public and the government.

In other countries, attempts to introduce population registration have been unsuccessful. As noted above, the attempt to introduce a National Identity Card in the United Kingdom met with considerable public opposition and was scrapped in early 2011. In Australia, attempts to introduce a universal 'Australia Card' in the mid-1980s and a Health and Social Services Access Card (dubbed 'Australia Card Lite') in 2006 both met with strong public opposition and were abandoned (Parliament of Australia 2006, Redfern 1989).

28. The respondent's Social Insurance Number was neither requested nor used to link to the tax files.

There must be a universal Personal Identification Number (PIN) that can be used to link administrative data across sources at the unit level.

Canada:

Canada has no universal PIN. The closest to this is the Social Insurance Number (SIN), but it is not universal and its usage is strictly limited by legislation and Treasury Board of Canada Secretariat policy.²⁹ The use and administration of the SIN has been the subject of numerous studies and audits over the years.³⁰ On each such occasion since the introduction of the SIN in 1964, the government has rejected its use as a personal identifier.

A wide variety of identification numbers are used for other administrative purposes (e.g., health insurance, drivers' licences, education, passport). There are no links between these other identifiers and the SIN.

Other countries:

All of the countries that conduct a register-based census have universal PINs that are used to link registers at the unit level. In many countries, these PINs are used to access a wide variety of government services. In the case of Switzerland, a new PIN was issued to all residents as part of the new census legislation. In other cases (e.g., Austria and the Netherlands), special approaches involving encryption of PINs may be needed to use them for statistical purposes.

29. See Appendix A of Treasury Board of Canada Secretariat (2008) for a complete list of permitted uses. In addition, there are over 150 provincial/territorial acts that mention SIN use in their texts (Source: Service Canada website).

30. See, for example, Reports of the Standing Committee on Human Resources Development and the Status of Persons with Disabilities (House of Commons Canada 1999 and 2003a), Reports of the Office of the Auditor General of Canada (OAG 1998, 2000 and 2002) and Human Resources Development Canada (1999).

The country must have a well-developed set of register systems that fulfil administrative needs but that also contain data covering the most important subject areas for the statistical system. At a minimum there must be a population register, a business register, and a building/dwelling register. The coverage of the registers and the quality of the data contained within them must be sufficiently high to be useful for statistical purposes.

Canada:

Canada has no population register analogous to those in countries that conduct a register-based census. Although there are a number of administrative databases (e.g., income tax, electoral rolls, and provincial/territorial health care records) that cover parts of the population for specific administrative purposes, none of these registers is sufficiently comprehensive for census purposes, nor are there common identifiers that would permit them to be linked to create a more comprehensive database. Several of these administrative registers (e.g., health insurance, drivers' licences) are under provincial/territorial jurisdiction.

The possibility of developing a national identity card system for Canada was raised by the minister of Citizenship and Immigration in 2003. The Standing Committee on Citizenship and Immigration studied the question and issued an interim report in October 2003 (House of Commons Canada 2003b). As part of its study, the Committee reviewed prior considerations for a national identity card, reviewed polling results, held hearings, and visited a number of European countries already using or planning to introduce national identity cards. Although the interim report of the Committee made no specific recommendations for or against the concept of a national identity card, it noted that the majority of witnesses before the Committee came out strongly against the idea of a national identity card system.³¹ The Committee also identified a list of questions that would have to be answered before the concept could proceed. As of this writing, there do not appear to be any plans for the government to introduce a population registration program.

Statistics Canada has an Address Register (AR). Coverage of the AR is very good in urban areas, but weaker in rural areas. The AR was designed with mail-out of census questionnaires as its primary objective, and is not a true building/dwelling register. As well, a major source of updates for the AR is the traditional census itself.

Statistics Canada's Business Register (BR) is generally of high quality, but is primarily designed for conducting business surveys. It excludes some small unincorporated non-employer businesses, although such businesses are not economically significant in most industries. The BR does not appear to have been evaluated as a source of data (e.g., place of work) for individuals.

Other countries:

All countries using the register-based approach first developed population registers for administrative, not statistical, purposes (ONS 2005b, Redfern 1989). In the cases of buildings and dwellings, additional data collection has sometimes been needed to construct a dwelling register (e.g., Norway and Sweden), and a method of keeping it up to date is required.

The experience of other countries is that once a central population register is established, it can be used in the census within 5 to 10 years, but full elimination of data collection can take several decades. In some cases, some census content may need to be dropped (e.g., occupation and languages spoken, in the case of Austria). In other cases (e.g., Germany, Switzerland and the Netherlands), the register-based approach must be supplemented by additional data collection, which may itself be mandatory.

The creation of a National Population Register in India is undoubtedly the most ambitious project of this type ever attempted. At this point how successful it will be is unknown and its role in the 2021 Census, if any, is yet to be defined.

31. For example, see *Why We Should Resist a National ID Card for Canada* (Privacy Commissioner 2003).

There must be incentives, such as a legal requirement, for the population to register and to inform the register authorities of changes of address. There must also be a reliable way to assign the units included in the registers (e.g., persons, businesses, dwellings) to a detailed geographic level (geocoding) in order to produce small-area detail.

Canada:

Canada has no population register and no universal legal requirement for Canadian residents to register changes of address with the government. Other methods for detecting address changes (e.g., voluntary reporting or using administrative files, such as tax records or driver's licence files, as a source of address updates) might be considered, but further investigation would be needed to determine whether the quality of address updates would be acceptable for statistical purposes.

Addresses on the AR and businesses on the BR are generally geocoded to the small-area level. For the AR, the geocoding is based on the data holdings in the geographic databases and information from the previous census. In the case of the BR, an assessment of the quality of the geocoding would likely be required to determine whether it would be sufficiently accurate for census purposes.

Other countries:

In countries with population registers, it is generally the case that the population is required by law to register and to report any change of address to the register authorities. Geocoding is normally accomplished through the building/dwelling register and in some cases through the business register. Persons are linked to the dwelling register through their PIN, thus allowing the geocoding of persons and the determination of the household composition. The central population register may also contain references to parents and spouses, allowing families to be identified and geocoded. Linkages to the business register allow the place of work to be geocoded.

Dates of changes or events (e.g., change of address, change of employers, births and deaths) must be reliably recorded with minimal delay in recording the event.

Canada:

Records of births and deaths of persons are generally reliable and are provided to Statistics Canada by the provinces and territories, with the timeliness dependant on their administrative processes. Immigration records are comprehensive, although some of the associated information (e.g., address in Canada, date of entry) may be imprecise. There is no legal requirement for persons leaving the country to report their departure, nor is there any requirement to report internal migration.

The AR is currently updated in advance of the census by field-canvassing methods, and again after the census using the census results. Administrative sources, such as telephone files, are used to update the AR between censuses.

The BR is maintained using administrative data from the Canada Revenue Agency and survey feedback. There are some delays in recording events; particularly problematic is the identification of businesses that have ceased to exist.

Other countries:

'Births' and 'deaths' of units (persons, addresses and businesses) are among the main events of interest. The Nordic countries report that in practice it is often difficult to pinpoint the real date of an event, as distinct from the date on which the event was recorded (UNECE 2007, paragraph 125).

Prompt reporting of events to the register authorities is the norm due to its mandatory nature. For example, in the Netherlands, all births must be registered within four working days, otherwise the parents receive a fine. In Finland, the allowable period to report a change of address is seven days.

Summary

Canada currently does not meet any of the necessary conditions for carrying out a census employing administrative registers as the primary methodology. The legislative framework is not complete, nor has there been any public consultation with stakeholders or the Canadian public on the possibility of basing the census on administrative registers. Most critically, the required administrative infrastructure does not exist: there is no PIN, there is no population register, and existing registers are not complete enough to support a population census in their present forms.

5.3 Censuses employing continuous measurement

The necessary conditions for the traditional census with yearly updates of characteristics and for the rolling census are very similar, and are treated together.

They generally require a multi-year program of comprehensive planning, development and testing to implement.

Canada:

To produce small-area census data in the same time frame as the 2016 Census or NHS, a continuous sample survey would have to start full-scale data collection in early 2012, in order to accumulate sufficient sample by 2016. The sample size of such a survey would depend on whether it would be used to replace only the long-form data (as in the United States) or as a complete replacement for the 2016 Census (as in France).³²

At this point, no development or testing of a continuous survey to replace all or part of the census has been conducted, nor does Statistics Canada appear to have made any assessment of the amount of time required to do so. Based on my experience, it is very unlikely that such a survey could start collecting data any earlier than mid-decade, even if development work were to start almost immediately. There is no possibility that data collection could begin by 2012.

32. The legal implications of a continuous measurement approach are considered in Section 7.3. For the purposes of this analysis, it is assumed that any data collected by a continuous measurement approach would be required in the same time frame as the 2016 Census/NHS. However, if such content were to be legally separated from the census, a later start date would be possible. See Section 6 for further discussion of such a scenario.

Other countries:

The United States took 18 years (from 1993 to 2010 inclusive) from the research proposal stage to the first publication of five-year estimates. The lessons learned from the pioneering efforts of the U.S. Census Bureau could shorten this period for Canada to some extent, but Canada would likely require the same four phases of development, testing, demonstration and full implementation.

In particular, the United States implemented the ACS only after a comparison of the 2000 Census long-form data to the corresponding data from the demonstration ACS, dropping the long-form content from the Decennial Census only in 2010. Because much of the value of census data is in tracking long-term trends, such a 'parallel run' in the 2016 Census might be considered indispensable by data users in order to understand the effects of such a major change in methodology.

In a scenario where a demonstration phase would be conducted in parallel with the 2016 Census, the development and testing phases would have to be completed by 2015. For the continuous survey to generate small-area long-form content in the time frame of the 2021 Census, the survey would have to start full-scale data collection by 2017. Statistics Canada would have to assess in further detail its ability to meet such a schedule while also conducting a full 2016 Census and/or NHS, but at this point, such a scenario would appear to be very high risk.

The U.S. Census Bureau also conducted a test of voluntary response to the ACS in 2003. The test showed the results of making response to such a continuous measurement survey voluntary: lower response rates, lower data accuracy, and higher costs to maintain the same level of quality.

The development of the rolling census in France took 12 years (1997 to 2008 inclusive) from the initial proposal stage to the first full production of results. The approach is still new, and is in a phase of evolution as lessons are learned and incorporated into the methodology. Nevertheless, it appears to have achieved its primary goal of making data available on a more regular and timely basis.

They require the agreement of census stakeholders and policy-makers to move from a once-every-5- or 10-year snapshot to an annually updated multi-year approach.**Canada:**

There does not appear to have been any broad stakeholder consultation in Canada on a continuous measurement approach to collecting census data. Canada has conducted a national census every five years since 1956,³³ so the trade-offs for users in Canada may be quite different than for countries such as the United States and France, where the traditional censuses previously occurred every 10 years (United States) or at irregular periods of 6 to 9 years (France).

33. The decennial census of Canada began in 1871. Special mid-decade censuses of Alberta, Saskatchewan and Manitoba were conducted in 1906, 1916, 1926, 1936 and 1946. The mid-decade census became national in 1956.

Other countries:

The main driver behind the ACS was the need to improve the timeliness of small-area socioeconomic data compared to the Decennial Census. The U.S. Census Bureau has expended extensive efforts on consultation and training of data users on the new type of data.

For example, users need to be taught that although multi-year estimates from a continuous measurement approach are updated annually, this really means that the oldest year of data is dropped and replaced by the newest year, i.e., the estimates are not based on completely new data.³⁴ In addition, it is important that users choose the correct set of estimates to use when analyzing data. Large geographic areas may have one-year, three-year and five-year estimates available while small areas only have five-year estimates; in such a case, the user would have to know to use the five-year estimates for all areas if the estimates are to be compared.

In France, legislative changes were required to move to an approach based on continuous measurement over a five-year rolling period and on the production of official population figures using a 40% sample, instead of a complete enumeration, in the larger communes. The French approach avoids the problems of having estimates for time periods with different lengths (all estimates are based on five years of data), but this requires a considerable degree of mathematical modelling. Canada would have to assess the extent to which such modelling would be legally acceptable in the Canadian context, and possibly modify the approach.³⁵ The French approach also means that even the estimates for large geographic areas are based on five years of data, even though the sample sizes for such areas might be sufficient to produce reliable one-year estimates.³⁶

Both the United States and France have found that a substantial amount of user support is required to interpret the data. In both cases, the approaches are fairly new, and lessons are still being learned. Any user consultation would have to carefully explain the strengths and weaknesses of updated time-period averages or estimates that involve a substantial element of statistical modelling.

34. For example, for the ACS five-year estimates, it takes five years for a completely fresh set of estimates to be published. From this perspective, the average timeliness of the five-year estimates and a census conducted every five years is comparable. One-year and three-year averages would of course have more of a timeliness advantage.

35. The Canadian census does include a small amount of estimation in its methodology. For dwellings where no one could be contacted or which were erroneously classified as unoccupied, data are imputed based on the results of a follow-up sample survey known as the 'Dwelling Classification Study.' Apart from this small adjustment, the census results are based on the actual enumeration.

36. Annual estimates at the national and regional levels were produced during the first few years of the rolling census until a full five years of data were available, but only the five-year estimates are now published.

A geographic infrastructure (address list or maps) is required, but unlike the traditional census, the infrastructure must be continuously updated rather than being updated once just before the census.

Canada:

Continuous updating of the AR is a long-term goal, and significant progress has been made in the past few years to develop and use administrative sources and targeted field canvassing operations, with the eventual goal of supporting the ongoing household survey program as well as the census. However, a major source of updates to the AR remains the results of the census itself. Considerable development and testing would appear to be needed to determine whether updates could be made from other sources alone that would support a large-scale ongoing survey program.

Alternatively, area sampling methods similar to those used in the current Labour Force Survey could be used. However, this would result in a less efficient sample and therefore a higher required sample size and increased respondent burden, due to the multi-stage methods inherent in an area sample approach. Area samples also deteriorate over time and need to be refreshed occasionally, based on an up-to-date census.

Other countries:

Both the United States and France made major investments to upgrade and maintain their address lists. In the case of the United States, their Master Address File covers (in theory) 100% of the country. In the case of France, the lists are not yet of sufficient quality in the smaller communes, so a rotating census of communes is used instead of sampling addresses directly, as in the larger communes.

The French approach is very dependent on the administration and infrastructure context that is specific to France. Using such an approach in Canada would likely require adaptation, in particular to take account of the differences in the geographical dispersion of the population and in the administrative responsibilities for data collection in Canada. Considerable development and testing would probably be required.

Several years of data collection (three or five) are required before the first data for smaller areas can be made available.

Canada:

As noted above, using a continuous survey to produce small-area data in a time frame equivalent to a 2016 Census long form or 2016 NHS would require that the continuous survey begin collecting data by 2012. Such a start date is not possible, and at this point, Statistics Canada does not appear to have formally assessed what a feasible start date could be.

Other countries:

In the case of the ACS, it took one, three and five years of data to produce estimates for, respectively, areas of 65,000 or more, areas of 20,000 or more, and all other areas. In the case of France, it took five years of data collection before the first estimates were produced, for all areas.³⁷ However, all estimates can now be updated annually.

They require substantial annual funding rather than funding clustered in a one- or two-year period around census year.

Canada:

The current census funding model is based on supplementary funding, with a peak in census year. Funding is under the control of the federal government, and could presumably be allocated in a different manner, but at the present time no funding of any kind appears to have been allocated for the development of a continuous measurement approach.

Other countries:

In the case of the ACS, there was a two-year delay in implementing the approach due to budget problems, although funding now appears to be stable. Because the Canadian census is required to be conducted in specific years by the *Constitution Act* and the *Statistics Act*, Canada has not experienced delays in conducting the census for budgetary reasons. If Canada moved to a continuous survey that was legally separate from the census, the continuous survey could become subject to such budgetary uncertainties.

In the case of France, the postwar traditional censuses were often postponed due to budgetary problems. The new rolling census approach, together with the new legislation underlying it, spreads the costs more evenly and has resulted in more consistent data production.

Because they are more complex, both in terms of their operations and the resulting data, they require a high level of professional staff to maintain them and users with the ability to interpret the data.

Canada:

In principle, Statistics Canada has the professional capacity to undertake the development of a large-scale continuous sample survey. However, an important part of this capacity is allocated to the 2011 Census and the 2011 NHS. Under current conditions, it appears unlikely that these employees could begin development work on a continuous sample survey approach before 2012 or 2013, when work on the 2011 Census and the 2011 NHS respectively is completed.

37. Annual estimates were produced for national and regional levels during the first few years, but all estimates are now based on five years of data.

Other countries:

The U.S. Census Bureau and INSEE have had the professional capacity to develop and maintain a continuous measurement approach. The key issue is how this capacity was organized in order to switch over to a new approach.

In the case of the United States, two separate organizations within the U.S. Census Bureau were established to develop the ACS and the 2000 Decennial Census. Once the ACS was fully implemented, the ACS and the Decennial Census became part of the same directorate.

In the case of France, a separate organization was set up within INSEE in 1997 to develop the rolling census, at the same time that the 1999 Census was being carried out. From 2001 to 2004, the organization grew into a special project team reporting directly to the director general of INSEE, given the challenges and implications for INSEE of the new approach.

If Statistics Canada were to develop an approach involving continuous measurement at the same time as it was planning and conducting the 2016 Census and/or the NHS, it would likely wish to establish a separate organization to do so, as the U.S. Census Bureau and INSEE did.

The ability of users to interpret time-period average data instead of point-in-time data is still in evolution. The United States published its first five-year estimates only recently (December 2010).

Summary

With the possible exception of a geographic infrastructure, Canada currently appears to meet none of the necessary conditions to replace all or part the 2016 Census/NHS by a continuous sample survey. To replace all or part of the 2016 Census/NHS, such a survey would have to be fully implemented by 2012, but no funding currently exists, no development and testing of this option has been conducted, no broad consultation with stakeholders has been conducted, and the necessary staff are allocated to the 2011 Census and the 2011 NHS until 2012 and 2013 respectively.

A continuous sample survey approach might be feasible for the 2021 Census, provided that there is stakeholder support for the approach, that the necessary funding is put in place and that arrangements are made to free up the necessary staff.

6. Options retained for further study for the 2016 Census

Based on the analysis in Section 5, it is my conclusion that the only methodology approach that can be implemented by 2016 is a traditional census. Neither a register-based approach nor a continuous measurement approach can be put in place in the time frame required for 2016.

This leaves the question of what potential variants of a traditional census are feasible for 2016. This question can only be answered once some key considerations are more fully examined. For each such consideration, trade-offs among competing factors will need to be made to arrive at a suitable methodological design.

The first consideration is the appropriate use of mandatory and voluntary response methodologies in any future design. The designation of a question or related group of questions as mandatory or voluntary involves a trade-off among the following factors:

- the importance of the requirement for the data, whether it be for legal or for other reasons
- the degree of privacy-intrusiveness of the question
- the accuracy of the resulting data, in particular the risk of non-response bias
- the relative costs of collecting the data on a voluntary basis compared to collection on a mandatory basis.

Historically, some questions have been considered to be more inherently privacy-intrusive than others.³⁸ In theory, designating a question as voluntary makes it less intrusive, because the respondent is not legally required to answer the question. However, making a question voluntary increases the risk of non-response bias, due to the lower and less evenly spread response rate that may result. Collection costs when response is voluntary may also be higher if more effort is needed to convince the public to respond.

The 2011 NHS is the first time that a voluntary approach has been used to collect data that were previously collected as part of a mandatory census. More information on the accuracy of the NHS data and the costs of data collection will only become available later in 2011 and in 2012. Statistics Canada will be in a better position at that time to assess whether proceeding with a voluntary survey vehicle in 2016 is a desirable option. At this point in the development of the 2016 Census strategy, it is recommended that options for 2016 should leave open the question of the boundary between mandatory and voluntary collection vehicles.

In addition, I recommend that the criteria used to decide whether questions should be mandatory or voluntary in 2016 should, where possible, be made more explicit and quantifiable than in 2011. A useful starting point could be Statistics Canada's existing criteria, described in *The Determination of Mandatory and Voluntary Surveys Guidelines* (Statistics Canada 1997).

The second key consideration concerns the role to be played by sampling, i.e., whether questions are asked of every household or of only a sample.³⁹ When considering the use of sampling, the trade-offs are primarily among:

- the accuracy of the resulting data, in particular the magnitude of the sampling error for small areas and population subgroups
- the costs to collect and process the data (sampling generally reduces costs)
- operational considerations, i.e., the sample design should be possible to implement in the field
- the total burden on the population (sampling reduces the average number of questions asked per household).

38. For example, the income question has traditionally been considered the most intrusive, which accounts for its placement near the end of the questionnaire.

39. Sampling is explicitly provided for in the *Statistics Act* and is used in numerous statistical programs.

By combining the type of response (mandatory or voluntary) with the choice of using sampling or not, the potential 2016 content can be grouped into the following three 'building blocks' for a 2016 Census/NHS design.⁴⁰

Block 1: Content that is required by legislation or where the need for highly accurate data is otherwise sufficiently important that it must be collected on a mandatory basis from 100% of the population. An example of such content might be the questions contained in previous census short forms, e.g., name, address, date of birth, sex, marital status, relationship to reference person in the household and mother tongue. Content in Block 1 would be considered to be part of the census under the *Statistics Act*.

Block 2: Content that is required by legislation or where the need for highly accurate data is sufficiently important that it needs to be collected on a mandatory basis, but only for a sample of the population. An example of this kind of content is a set of language questions that were previously on the census long form. Because this building block did not exist for 2011, but the questions were legally required to be collected as part of the census, the only solution for 2011 was to move them to Block 1. Because of its mandatory nature, content in Block 2 would also be considered to be part of the census under the *Statistics Act*.

Block 3: Content that only needs to be collected on a voluntary basis and only for a sample of the population. All of the questions in the 2011 NHS were considered to be of this type. Because it would not be part of the census according to the *Statistics Act* due to its non-mandatory nature, a wider variety of design options are possible for this building block, as discussed below.

Any 2016 or future Census would have to include some content in Block 1 to be considered a census. Consequently, there are four basic configurations (options) for a 2016 Census/NHS design, depending on the presence or absence of Blocks 2 and 3:

Option 1: Block 1 only (i.e., a single form census, no voluntary data collection). This is, in effect, the design that was used in every Canadian census from 1871 to 1966, when there was only one census questionnaire and it was mandatory.

Option 2: Block 1 plus Block 2 (i.e., all questions are mandatory, some are asked of 100% of households while others are asked only of a sample). This is the configuration that was used from 1971 to 2006, where a short and a long questionnaire were used, and both were part of the mandatory census.

Option 3: Block 1 plus Block 3 (i.e., some questions are asked on a mandatory basis from 100% of households, while the remaining questions are asked on a voluntary basis of a sample of households). This is the configuration that was used in the 2011 Census/NHS approach.

Option 4: Blocks 1, 2 and 3 (i.e., some questions are asked on a mandatory basis of 100% of the population, a second set of questions is asked on a mandatory basis but only from a sample of households, and a third set of questions is asked on a voluntary basis from a sample of households).

To my knowledge, Option 3 has only been used in Canada (in 2011 for the first time), and Option 4 has not been used in any country. Option 4 would provide the most flexibility for the collection of content, but would also be the most complex.

40. In theory, one could have content that is required of 100% of the population but only on a voluntary basis. In practice, it is difficult to imagine content that would be of this type. Question 10 of the 2011 Census, which asks the respondents whether they give permission for their responses to be released in 92 years, could be considered to be voluntary by the way it is worded, but technically it is part of the census.

In conducting the more detailed assessment of these four basic design options, several more explicit considerations for sample design could be examined by Statistics Canada.

First, for any of the options involving sampling (Options 2, 3 and 4), the basic long-form/short-form methodology could be re-examined.⁴¹ One drawback of the approach that has been used in Canada to date is that the number of questions to be answered by each household is unevenly spread; a household receives either a short questionnaire containing the minimum number of questions, or a long questionnaire containing the full set of questions. Other sample designs that would spread the respondent burden more evenly could be considered. One possibility, as proposed in Australia, is to have several different forms, with core questions on all forms and different sets of thematic questions on different forms. Another possibility is the so-called 'matrix' sampling, where questionnaires consist of various combinations (e.g., AB, AC and BC) of various content modules (A, B and C in this example). The drawbacks of such approaches are the inability to cross-tabulate variables that appear on different forms, as well as the extra complexity and costs of having several different versions of the questionnaire to print, deliver, capture and process.⁴²

Second, for Option 3 (the 2011 Census/NHS approach), the NHS sample design could be re-examined. As noted above, the 2011 NHS sampling fraction was set at one in three in order to keep the achieved sampling fraction roughly comparable to that of the 2006 Census long form. Sampling is also used for follow-up of non-response in order to mitigate the risk of uneven response rates across important subgroups of the population. Once the actual response rate to the 2011 NHS is known, as well as the effectiveness of using sampling for non-response follow-up, the sample design for a 2016 voluntary survey could be further refined. For example, it might be desirable to lower the overall sampling fraction but to follow up a higher fraction of non-respondents, or to use a higher overall sampling fraction but follow up a lower fraction of non-respondents.

For Option 4, which would include both mandatory and voluntary questions on a sample basis, there would be the issue of whether the two sets of sample questions should be asked of overlapping samples or of separate samples (known as 'positive coordination' and 'negative coordination' respectively). There are advantages and disadvantages to both approaches (for example, see Royce 2000). The sampling fractions for the mandatory and the voluntary sample questions could also be different. For example, because the voluntary component would presumably have less content than in 2011, consideration could be given to reducing the sampling fraction in order to keep the overall costs the same, at the expense of a higher sampling variance for those data items collected on a voluntary basis.

Finally, because any voluntary questions (i.e., Block 3 content) would not be considered to be part of the census under the *Statistics Act*, there is no legal requirement to collect Block 3 at the same time as the census. Collecting the data in close proximity to the census does have operational and statistical advantages (e.g., the census data can be used to weight the sample data), but the possibility of collecting them at a different time, or using a continuous collection approach for censuses beyond 2016 could be considered.

41. A long-form sample has been used in the Canadian census since 1971 (Statistics Canada 2009), with a one-in-three fraction used in 1971 and 1976 and a one-in-five fraction from 1981 to 2006. The 2011 NHS has a sampling fraction of one in three.

42. The matrix sampling approach (also known as 'interlocking sampling') was in fact considered in Canada in the past. The inability to cross-tabulate questions on different forms is one reason it has not been used, but another reason is that it is more complex for enumerators to implement. With the change to mail-out of census questionnaires based on the AR that began in 2006, this latter limitation may be lessened.

If either Option 3 or 4 were chosen, and the mandatory and voluntary content were collected in the same time frame, one could consider the extent to which data collection for the mandatory and voluntary questions should be more closely integrated. In the case of the Internet response channel, this is already the case; if the household is selected for the 2011 NHS, the invitation to complete the NHS questionnaire appears immediately after the respondent has submitted his or her completed census questionnaire. However, for self-responses on paper, separate census and NHS forms are used, and the collection for the NHS starts approximately one month later than for the census.

For 2016, consideration could be given to asking mandatory questions and voluntary questions on the same paper questionnaire, for those households which receive both types of questions. Such an approach is used to a limited extent in some other countries, including Australia, New Zealand, the United Kingdom and Hungary, where a question on religion appears on the census questionnaire but is designated as optional. Closer integration of the census and NHS paper questionnaires would reduce response burden by not asking NHS households to report the basic information (date of birth, gender, language, etc.) on both the census form and again on the NHS form,⁴³ as is the case in 2011, and might help to increase the response rates for the voluntary questions. The potential for cost efficiencies by combining the questions onto one form should also be examined.

On the other hand, the effects of mixing mandatory and voluntary questions on a single form need to be carefully considered. Doing so could conceivably put at risk the respondent's willingness to complete the mandatory questions, and could have negative effects on the amount of follow-up required to complete the census. Closer integration might also reduce Statistics Canada's flexibility to shift resources from the voluntary to the mandatory content if this became necessary. Field testing would be needed before proceeding with any integration of mandatory and voluntary questions and other aspects of the data collection operation. The experience of the integration of the census and NHS in the Internet response channel in 2011 would have to be carefully evaluated.

For all options, Statistics Canada should continue to build on the success of the use of income tax records to replace data collection in the 2006 Census by increasing the use of administrative data wherever possible. For example, consideration could be given to removing the income question completely from the questionnaire and simply informing respondents (as required by Statistics Canada's *Policy on informing survey respondents*) that Statistics Canada will be linking to their tax records, instead of asking them for their consent. In theory, this would permit tax data to be used for 100% of the population, effectively turning it into a short-form variable. In practice, there may be special populations with low rates of tax filing where the question would have to remain on the questionnaire, so further work would be needed to determine whether and exactly how this might be implemented. Statistics Canada would undoubtedly wish to test such an approach to ensure its public acceptability.

Statistics Canada should also consider whether there are administrative sources of data for some of the other content on the census or NHS questionnaire. In this regard, it would be worthwhile to examine in more detail the experiences of countries that use administrative sources for such variables. To date, the experiences of the countries that have been examined suggest that variables such as occupation, educational attainment and place of work are the variables that are often difficult to obtain from registers, or that are not available for particular subgroups of the population (e.g., education of older persons, place of work of the self-employed).

43. In the case where the respondent completes both the 2011 Census and the 2011 NHS by Internet, the census responses are automatically copied over to the NHS, thus avoiding any additional burden.

Finally, it is recommended that consideration should be given to additional possibilities for using administrative records within the traditional census approach, such as further improving the process for updating the Address Register, targeting non-response follow-up, or imputation of non-response. A separate project on the future uses of administrative data is being conducted and is expected to report later in 2011.

7. Potential approaches for the 2021 Census and beyond

The primary purpose of this study was to identify and provide an initial assessment of methodology options for the 2016 Census. The study also helped to identify potential approaches which, although not feasible for 2016, could be considered for the 2021 Census or beyond. In this section, I provide a brief overview of three potential approaches for this longer time frame. Considerably more work would be needed by Statistics Canada to develop and assess these approaches in detail before decisions about the census methodology for 2021 and beyond could be taken.

7.1 A register-based census based on a new Central Population Register

For Canada to conduct a future register-based census modelled on those conducted in countries with administrative registers, the following developments would likely be needed.

First, a government-wide business case for establishing a Central Population Register (CPR) would be required. The question of how much such a CPR would cost to establish and maintain cannot be fully answered at this point, but some estimates of the magnitude of the costs are available from existing sources. A 1999 study (HRDC 1999) estimated the cost of establishing a 'Common Client Identifier,' supported by biometrics technology, at between \$1.1 billion and \$3.6 billion. The 2003 submission of the Interim Privacy Commissioner to the Standing Committee on Citizenship and Immigration estimated the start-up costs of a national identity card system at \$3 billion to \$5 billion.⁴⁴

The cost of the 2011 Census/NHS program is approximately \$660 million, so it is unlikely that a CPR would be cost-effective solely on the basis of replacing the census. A CPR would need to provide additional offsetting savings and/or benefits to the government, such as security enhancement, fraud prevention and administrative efficiencies. Statistics Canada would probably not be capable of assessing these aspects of the business case.

As part of the establishment of a CPR, the government would need to adopt a universal (and therefore mandatory) PIN as well as legislation permitting the use of the PIN for linking the CPR and other administrative registers for statistical purposes. Such legislation should also include data protection measures. A universal PIN might be established by making the existing SIN universal, or, as in Switzerland and India, by issuing a new PIN to all Canadian residents (both permanent and non-permanent).

The reporting of changes of address to the register authorities would ideally be mandatory (e.g., as currently required for a driver's licence) in order to keep the CPR up to date, so that it would be useful for both administrative and statistical purposes.

44. These cost estimates exclude ongoing maintenance costs, and they have not been adjusted for either inflation or population growth since they were tabled in 1999 and 2003 respectively. Also, HRDC's 'Common Client Identifier' would not have been a universal identifier; it was intended to cover only clients of HRDC services.

The acceptability to both the public and census stakeholders of using the CPR to conduct all or part of the census would also have to be established. The privacy impacts and public acceptability of trading off mandatory registration and reporting of changes of address with no longer having to complete part of the census would need to be determined.

If a CPR were to be established, it could likely be used as the basis of the census within 5 to 10 years. To eventually move to a register-based only census, additional registers (e.g., education, dwelling, employment, families) would have to be developed to cover content that is not available in existing registers. The feasibility and the costs to develop these registers would need to be assessed. The experience of other countries suggests that it could be several decades before the content and the data quality of such registers would be sufficient to adopt a register-based only census; in the meantime, the CPR would have to be supplemented by surveys and/or complete enumerations to collect the additional content.

Finally, some of the content that is currently collected in the census or the NHS might never be part of any register, for example ethnic origin, visible minority status or mode of commuting to work. Surveys would still be required if data on such topics are important. The costs to conduct such surveys would have to be assessed.

The major cost and privacy implications of these developments make it appear unlikely that they would occur in time for the 2021 Census. Because of this, I recommend that the approach not be pursued for 2021.

7.2 Keeping the census up to date through administrative data and surveys

A second potential approach is to keep the results of a traditional census up to date by using a combination of existing administrative files and surveys, without the construction of a Central Population Register and the creation of a PIN.

One scenario for the 2021 Census might be to begin with the 2016 Census as the base population, and attempt to update it with birth, death, immigration and other records that capture demographic and other changes. Changes of address of individuals might be updated from existing administrative records (e.g., tax files) and linked to dwellings via the Address Register. Statistics Canada might also exploit the expertise it has developed in forming families in the T1 Family File⁴⁵ to create families and households.

A large sample (possibly several million households) might then be selected from this updated population and household database and intensive attempts made to trace and interview the individuals, using the expertise developed in the census coverage measurement studies and longitudinal surveys. The results of the survey might then be used to adjust the database using small-area estimation techniques,⁴⁶ for example, for over- or under-reporting of address changes, emigration or changes in household

45. The T1 Family File (T1FF) is created from personal income tax records (known by the form number, T1). It uses information about spouses and children included on the T1 and other Canada Revenue Agency forms to create families that are similar, but not identical, to the concept of a census family. While the overall coverage of the T1FF is comparable to the census, at approximately 96% to 97%, the coverage at detailed levels such as single years of age is highly variable. For example, compared to official population estimates, 18-year olds are overestimated by 22%, and 19-year olds are underestimated by 15%, simply because of how the tax system works.

46. Small-area estimation techniques involve some degree of statistical modelling. If the assumptions of the underlying model are not valid, then the results will be biased.

composition. The sample survey might also be used to collect updated socioeconomic data and to adjust the database, again perhaps using small-area estimation techniques.

To the best of my knowledge there are no countries that actually use such an approach for conducting a census. Similar projects have been attempted on an experimental basis or considered in a few countries that do not have population registers. The U.S. Census Bureau conducted an Administrative Records Experiment (AREX) as part of their 2000 Census research program and is expanding the scale and scope of this research for its 2010 Census. France has developed a longitudinal database (Échantillon Démographique Permanent) of persons born on certain days of the year, and links demographic events (births and deaths) to the census forms. The United Kingdom has been considering an administrative records approach as one option for their 2021 Census.

If such a project were to be attempted, Statistics Canada should initiate research and testing relatively soon so that the methodology could be developed, administrative sources could be identified and linked, and samples could be selected and traced. In order to determine the feasibility of such a method for the 2021 Census, one could start with the 2011 Census, develop and apply the methodology, and compare the results of this approach to those of the 2016 Census. Even if the conclusion were to be that such an approach to conducting a census is not feasible in time for the 2021 Census, the lessons learned in the attempt could be very worthwhile in the longer term for increasing the use of administrative data in both the census and the household survey programs.

As part of such a project, it is suggested that Statistics Canada and the government should also confirm that no legislative changes are needed to permit existing identification numbers such as the SIN to be used to link such files, thus improving the quality of the linkage, and that additional administrative files, such as provincial or territorial health care files, could be used in such an approach. It is also recommended that the public acceptability of linking the census, administrative records and tracing surveys together to produce census-type data be assessed through public consultations prior to implementing such a methodology.

7.3 Continuous measurement approaches

Although a continuous measurement approach as used by the United States or France is not feasible in the time frame of the 2016 Census/NHS, it might be a feasible alternative for 2021 or beyond. A continuous measurement approach could become simply the source of long-form data, with a traditional short-form census still conducted every 5 or 10 years or, at the extreme, could potentially replace the census completely. It might be noted that a continuous measurement approach has no inherent advantage over a point-in-time census in terms of response burden or intrusiveness; in both cases, data are collected from the public. The primary motivation for a continuous measurement approach is improved timeliness.

As a first step, Statistics Canada and the government would likely need to assess the legal implications of the continuous measurement approach, particularly with respect to the legal requirement to conduct a census in specific years. For example, it would need to be determined whether continuous measurement could be considered to be part of the census under the relevant legislation. This determination would have implications for which questions could be part of the continuous survey or the traditional census and whether the continuous survey could be voluntary or not. The legal implications for the extreme form of continuous measurement, which departs completely from the current approach by replacing a census taken in specific years with continuous data collection, might be particularly significant.

Assuming that the legal implications would not be a barrier, the next step would be for Statistics Canada to consult users and other stakeholders to determine whether a continuous measurement approach would have any significant net advantages compared to the current approach of a census conducted every five years. The advantages and disadvantages (e.g., timeliness, frequency, averages versus single point-in-time estimates) would have to be carefully explained, and there should be widespread user agreement before proceeding. The role of a continuous sample survey within the broader context of the overall household survey program would also need to be assessed; for example, the uses of such a survey as a sampling frame for other surveys.

In parallel with the stakeholder consultations, Statistics Canada would need to conduct a feasibility study, including costs and timelines, for developing, testing, demonstrating and implementing a continuous measurement approach. In particular, Statistics Canada would need to estimate and compare the ongoing costs in a Canadian context of the traditional census approach, the traditional census with yearly updates of characteristics approach and the rolling census approach. Only one country has implemented each of the latter two approaches, and it would not be reasonable to simply extrapolate their cost structures to the Canadian context.

Finally, the new methodology would need to be developed, tested, demonstrated and implemented. Although Statistics Canada could benefit from the experiences of the United States and France, it would likely take at least 10 years for such a program and would require a significant long-term commitment of resources.

8. Next steps

This report has been reviewed by and has benefited from the comments of a number of internal and external bodies. It was first reviewed internally by the 2016 Census Strategy Senior Management Advisory Panel, consisting of four directors general, by the 2016 Census Strategy Steering Committee, consisting of four assistant chief statisticians, and by the Chief Statistician. The report was then reviewed in early June 2011 by an Expert Panel Review Committee and by a subcommittee of the National Statistics Council, both of which were formed to provide independent advice on the outputs of the 2016 Census Strategy Project.

The next step will be a detailed assessment by Statistics Canada of the options that it will retain for the 2016 Census and of the potential approaches for 2021 and beyond, using an assessment framework developed by Statistics Canada specifically for this purpose (Trépanier 2011). The framework is based on Statistics Canada's *Corporate Management Framework* (Statistics Canada 2011b), which in turn builds on and adds to Statistics Canada's *Quality Assurance Framework* (Statistics Canada 2002). The assessment framework describes each of the dimensions and sub-dimensions to be assessed (e.g., relevance, accuracy, response burden, costs, risks), and for each dimension and sub-dimension it describes the assessment criteria and the sources of data to be used. As more information about the accuracy and costs of the NHS data becomes available, the lessons learned from the 2011 approach will also be incorporated into the assessment of options for 2016. This detailed assessment is due to be completed by December 2011.

As part of the assessment of specific methodology options, it is recommended that work begin on the other considerations for the 2016 approach, in particular sample design considerations, the possibility of closer integration of mandatory and voluntary content, and the potential for increasing the use of administrative data in the census process. The extent to which this work can advance will likely depend on how quickly the 2011 Census and NHS can be evaluated and the lessons learned incorporated into the assessment of options for 2016, the level of resources (methodology in particular) that can be dedicated to the work, and the timeliness of the results of a related 2016 Census initiative examining how the 2016 Census should be integrated into Statistics Canada's Corporate Business Architecture.⁴⁷ At that stage, Statistics Canada would have to determine the suite of testing that is required before any option is implemented and, as a result, whether it would be feasible to implement that option successfully by 2016.

In addition, Statistics Canada should begin to assess the potential approaches for the 2021 Census and beyond in further detail and to flesh out a possible program of research and development. The direction for this research and development program will depend to a large extent on the suggestions and recommendations of the various external advisory bodies.

The results of this work, together with the findings of other subprojects, in particular the review of constitutional and statutory requirements and the development of the census content determination framework, are to result in the main 2016 Census Strategy Project report, to be available in 2012. This report will present an analysis of the options for 2016 and describe possible directions for the future.

47. Statistics Canada's Corporate Business Architecture comprises its business processes, computer systems and hardware, business rules and organizational structure. It is meant to strengthen the corporate governance of business processes and of the technologies and tools that support them. It helps create an environment in which the corporate interest guides Statistics Canada and in which the entire program is managed in a more integrated way.

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