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# Options for future New Zealand censuses

Census Transformation programme

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# 1 Background

## About this paper

This paper outlines potential options for future censuses in New Zealand. These options form the basis for investigative work to assess the feasibility of each option. The emphasis in this paper is on describing administrative census options.

This version forms an initial set of working assumptions. The options will be reviewed periodically as we learn more about them.

It is one of a series of papers that will be published over the next couple of years by Statistics NZ's Census Transformation programme.

## Census Transformation programme

The purpose of the Census Transformation programme is to modernise the current census model in the short to medium term, and to investigate alternative ways of producing small area population and socio-demographic statistics in the long term. This includes the possibility of changing the census frequency to every 10 years and exploring the feasibility of a census based on administrative data.

The two-fold approach is the basis of the Census Transformation Strategy, approved by Cabinet in early 2012. The programme will report to government periodically, outlining progress and seeking decisions on future direction. The first report will be in November 2013, and will include a budget bid for a probable 2018 Census. Further decisions will be sought in subsequent reports timed to coincide with the census cycle, with the second report in 2015.

The options for future censuses presented to Cabinet in March 2012 were:

- a five-yearly census cycle (as current), but significantly modernised
- a ten-yearly census cycle, possibly with an ongoing large-scale survey
- an administrative census.

[Transforming the New Zealand Census of Population and Dwellings: issues, options, and strategy](#) has background information to the Cabinet paper.



## 2 Introduction

### Current approach

The current New Zealand Census of Population and Dwellings is a periodic full enumeration census that produces a list of the population stock every five years.

The most critical information provided by the census is population counts by the key demographic variables: age, sex, ethnicity, Māori descent, and for small geographies. There is a legislative requirement for census Māori descent counts because of their use in the electoral system. Counts of dwellings by small areas are also a key output.

The other component of census information is a broad range of socio-economic information for the whole population that includes information about dwellings, households and families, as well as for individuals. Multi-variate information is available for small areas and small population groups, referenced to the time of the census. No other information source in New Zealand can provide a range of variables for small sub-groups.

The accuracy of the census population count is checked through a coverage survey run immediately after census, called the Post-Enumeration Survey (PES). Base population estimates for census year include an adjustment for net census undercount estimated from the PES.

In between censuses, population estimates are updated using administrative data. The methods measure population change (or flows) using aggregate data derived from births, deaths, international migration, and a range of partial information sources to inform internal migration measures.

### What makes a census?

The *UN Principles and Recommendations for Population and Housing Censuses* (United Nations, 2008) describes the main features of a census as:

- individual enumeration
- universal coverage of the population
- conducted at a single point in time
- defined periodicity.

While these features are met by the current approach to census in New Zealand, over recent years a number of other approaches to census-taking internationally have shown that they also can be considered a 'census' under the United Nations definition. These examples include censuses which include an ongoing survey component (a 'continuous measurement' model), and censuses based on a national population register and other administrative data.

## Modernise Census project

The Modernise Census project within the Census Transformation programme is investigating methods for modernising the full-enumeration census. This includes fundamental changes to delivery and collection of census forms. In future, census collection would be based on developing a national address listing that would enable mail-out of census Internet codes or paper forms, and a strong drive towards achieving a high level of Internet completion. These strategies would be employed with any of the survey-based census options.

This paper focuses on the longer-term possibilities for a census based on administrative data, rather than a survey of the whole population. The paper outlines broad options for conducting an administrative census. These administrative census options will be assessed alongside the survey-based census options when considering future direction.

## What is an administrative census?

Most approaches to running an administrative census aim to create a unit record list of the whole population, where the population list is derived from administrative (or commercial) sources. Characteristics about each individual could be obtained from a range of sources linked to their record on the population list. One aggregate model option is proposed.

While an administrative census may include a sample survey component, there would no longer be a need to survey the whole population as under the current full enumeration census. The periodic 'census' aspect would merge seamlessly with the ongoing production of population estimates.

## Further information

Options presented in this paper have been developed from more detailed consideration of issues. The potential for a register-based census in New Zealand is described in Bycroft, 2010. More detailed description of potential NZ approaches and options can be found in Bycroft, 2011 and Hughes, 2011. Statistics NZ, 2011 provides an overview of a range of existing administrative and commercial data sources that might be useful for producing Statistics NZ's population estimates.

The Office for National Statistics (ONS) has set up the Beyond 2011 programme to investigate and assess alternative options for producing the population and socio-demographic data required by users in England and Wales. This work will include testing models for the use of administrative and survey data as an alternative to the UK's traditional census approach. ONS, 2011, 2012, and 2013 list the census options identified by the Beyond 2011 programme at various stages of their development. In a similar manner, the New Zealand future census options presented below will be reviewed in the light of further investigation.



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## 3 Future census information requirements

The ability to meet census information needs will be one criterion used in assessing alternative census options. Other work will develop future census information requirements in detail. In preparing the future census options we make some broad initial assumptions about the two distinct aspects of census information – population and dwelling counts, and socio-economic information for small groups.

### Population counts

Fit-for-purpose population counts are the first requirement of a census. The [Population domain plan 2012: Draft for public consultation](#) sets out high-level information needs, however details about the exact breakdowns needed, and at what frequency and accuracy, requires further work. Starting assumptions could be based on current population estimates outputs. More fundamental issues may arise if registered or administrative addresses do not align with the current usual residence concept for population counts. For example, a legal address or postal address may not be the same as where people consider themselves to usually live.

In an administrative census, administrative or commercial sources would be used to measure the population stock, including breakdowns for key demographic variables, and up-to-date location (address).

Since any administrative census option is only feasible if population counts can be produced, the options focus first on possible approaches for population counts. In other words, the options are defined by how population counts will be produced. Since producing accurate population counts is also the most difficult aspect of census information, it makes sense to assess feasibility first in these terms.

### Coverage check for population counts

Just as the PES is used to measure and adjust for under-coverage and over-coverage of the current census, administrative census options will also need a means of independently checking the accuracy of population counts. Some type of coverage survey would be used for options that create a population list. A much larger coverage survey, and a different approach to its design, may be needed if the coverage survey must make adjustments for sub-national geographies, or if under-coverage or over-coverage of administrative options is higher than in the current census.

A significant part of the feasibility investigation of different options will be in the design of a suitable coverage survey, and designing adjustments to the raw administrative-sourced counts to produce population estimates.

### Socio-economic information for small areas and small sub-groups

The marginal cost of particular variables or for some detailed breakdowns is likely to be significantly different between a full-enumeration census and administrative options. While the current census content is prioritised into three groups for quality management, for the future we will need to distinguish essential census information requirements from aspects which are more 'nice to have'.

Agreement on essential socio-economic variables and essential sub-groups and geographic breakdowns will be reached through consultation and benefit analysis. Here we make assumptions based on the kinds of information provided by censuses. Starting assumptions are that:

- some range of socio-economic variables will be required
- units include dwellings, households and families, and individuals
- the ability to do multivariate analysis is required
- information will be required for quite small population sub-groups and small areas.

The full-enumeration census options use a questionnaire to obtain a range of socio-economic information about each of the units, and the questionnaire allows multi-variate analysis as a matter of course. In the current New Zealand census, information about small groups is limited only by confidentiality restrictions. Other census models give the long questionnaire to a sample of only some of the population, which introduces sample error and further restricts the size of small groups that information can be provided for.

In the administrative census options, socio-economic statistics for small areas and small sub-groups will be provided through some combination of administrative data and/or a large-scale survey. One approach is to include only variables that could be determined from existing administrative sources linked to the population list. This would be a purely administrative census, but may include much less information than at present, possibly at lower quality.

A combined census would include survey information to add to what is available from administrative data. A large-scale sample survey may be needed if the range of content, type of breakdowns, and quality were to be closer to what is obtained in the current census. The American Community Survey (US Census Bureau, 2008) offers a model for frequently updated census information from a sample survey. The detail available from a survey might be enhanced by small area modelling techniques.

The size of a sample survey is largely determined by how 'small' geographic breakdowns need to be, and by the size of population sub-groups. Early indicative work suggests that an annual survey of about 5 percent of the population would provide area unit information for data aggregated over five years. As these area unit estimates would include sample error, and the aggregation over time creates a more complex conceptual basis, it is less valued than the current census. Iwi are an example of a sub-population likely to be an essential 'small group' information requirement.

The question of whether to include a survey in an administrative census option is not so much one of feasibility, but on the return on investment.

## The role of an address list

A comprehensive national address list is an essential component of all options. Future full-enumeration censuses will rely on an address list for efficient delivery and collection of census forms. In an administrative census, a national address list allows addresses for individuals (obtained from various sources) to be verified and accurately geo-coded. It allows residents at the same address to be grouped together. A true national address register could also provide dwelling counts if sufficient information about the characteristics of the address were included.

## Assumptions

The assumptions underlying the future census options can be summarised as:

- fit-for-purpose population counts are the first requirement of a census
- coverage assessment for population counts is an essential component of an administrative census, as it is for the current census and each option assumes some form of coverage survey
- an administrative census would produce socio-economic statistics for small areas through some combination of administrative data and/or a large-scale survey
- a comprehensive national address list is an essential component of all options
- administrative census options that depend on a periodic census of any kind are out of scope.



## 4 Summary of options

Below is a list of the administrative and survey-based options for future New Zealand censuses. This version forms an initial set of working assumptions. They will be reviewed in mid-2013 and again periodically as we gain a deeper understanding of the options and their implications.

The 'survey-based' census options are a survey of the entire population at a specific point in time, where every household and individual is asked to fill in a questionnaire. These are also called 'full-enumeration' approaches. By contrast, an 'administrative census' obtains information from administrative registers and other administrative (or commercial) data sources, rather than directly from respondents.

We note that all options are 'on the table' at present. There is much that we do not know yet. Some form of administrative census is not a foregone conclusion. We may find that an efficient, largely online full-enumeration census, with greater input from administrative sources, is a better solution. Some new hybrid or combination of these options may emerge as a solution as we learn more.

### Options for a future New Zealand census

#### **Administrative-based census options**

Option 1: New Zealand Population Register, and unique identifier.

Option 2: Single primary administrative source for statistical population list.

Option 3: Linked administrative sources for statistical population list.

Option 4: Aggregate statistical model.

Option 5: Commercial and social media big data sources.

#### **Survey-based census options**

Option 6: Five-yearly census.

Option 7: Ten-yearly census.

Option 8: Ten-yearly short-form census with large-scale annual survey.



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## 5 Survey-based census options

The full-enumeration survey-based census options are now briefly described for completeness. We note that under the modernisation programme, the operation of future censuses under this model will be significantly different from previous censuses. We expect census to be essentially online in future (potentially paperless), and with a reduced field force. See Statistics NZ, 2012 and Bycroft, 2011 for further discussion.

### Five-yearly census

A survey of the entire population at a single point in time, conducted every five years. A questionnaire is administered to every household and individual in the country on census night. Data on a range of social and economic topics is collected alongside core demographic data. This is the current approach in New Zealand.

### Ten-yearly census

A survey of the entire population at a single point in time, conducted every 10 years. A questionnaire is administered to every household and individual in the country on census night. Data on a range of social and economic topics is collected alongside core demographic data.

Apart from the longer interval between censuses (every 10 years, rather than every five years), this is the same as the current approach in New Zealand.

### Ten-yearly short-form census with large-scale annual survey

A survey of the entire population at a specific point in time, conducted every 10 years, but asking core demographic questions only (short-form). A range of social and economic topics are asked separately in a large scale sample survey that runs continuously. The large survey provides updated census-type information every year, but results are less accurate than a full census due to sample error. For information on small areas and small groups, up to five years of survey results would need to be combined.



## 6 Options for a New Zealand administrative census: descriptions and issues

This section describes the main features of the administrative census options as we understand them at present. Key issues that affect their feasibility are highlighted.

An administrative census is one where census information is obtained largely from administrative (or commercial) sources. The Nordic countries, for example, have replaced their traditional census by a system of linked administrative registers, and no longer need to enumerate the whole population. While there are variations between countries, typically a national population register provides the essential population base and is linked to an address register, to birth and death registers, and to other administrative sources such as tax, health, and education data. Some countries also include a large survey component if the available administrative data is not sufficient. In the 2010 round of censuses, 15 countries reported a register-based census and 10 of those included surveys to capture census information not available from administrative data (United Nations, 2011).

The essential pre-conditions for a register-based census are a sound legal basis, public approval, unified identification systems, and the existence of suitable administrative data sources (Tonder 2008). The United Nations (2008) states that a country should have an established central population register of high quality and good coverage linked with a system of continuous updating.

This internationally proven approach is included as an option, even though New Zealand does not have a national population register, nor plans to introduce one. Statistical purposes do not provide a sufficient rationale for compulsory national population registers, so we propose as a first step to initiate discussion on the potential benefits of a national population register for the government and people of New Zealand.

The remaining administrative census options are possible approaches that might allow existing administrative sources to produce population statistics first of all, and then other census topics if possible. All the administrative options include a coverage survey that would be used as an independent check on accuracy, and to adjust administrative estimates.

### Option 1: New Zealand Population Register and unique identifier

A new New Zealand Population Register and common unique personal identifier would form the basis of a formal register-based census on the Nordic model.

Population counts would be obtained from the population register. The register should include the core demographic variables (for date of birth, sex, ethnicity, and Māori descent). A coverage survey would estimate any adjustments needed.

Socio-economic information would be obtained through other sources accurately linked to the population register via a common identifier. A large-scale survey could be used to provide additional variables if this were justified.

### *Issues*

Neither the administrative infrastructure nor legal environment exists at present in New Zealand. Key tasks include establishing the benefits of such an infrastructure for administration across government, and the likely political and public acceptability. The question of how a New Zealand Population Register could be established would be addressed only if the Government wished to pursue this option.

## Option 2: Single primary administrative source for statistical population list

A single primary administrative source would be used to provide a list of the population. Other data sources would be linked to supply demographic (or other) variables or obtain up-to-date address information.

Population counts would be obtained from the primary source. Demographic variables may come from several probabilistically linked sources. A coverage survey, possibly large, would estimate any adjustments needed.

Socio-economic information could be obtained through many sources probabilistically linked to the primary population list. A large-scale survey could be used to provide additional variables if this were justified.

### *Existing data sources*

The most likely existing administrative sources are tax data or health data. Coverage is good for some age groups, but young adults pose problems in all sources. Over-coverage is also a problem. Some key demographic variables are absent from each source, and the currency of address information is variable.

### *Emerging opportunities*

An identity authentication service could provide a population list compiled from details given at the time of signup. The highest level of authentication when dealing with government is provided through iGovt. The Department of Internal Affairs and New Zealand Post's [RealMe](#) initiative was recently launched as New Zealand's new official identity management and verification service. RealMe provides 'a secure online way to prove your identity to an organisation, such as a bank, insurance company or government agency'.

A digital postal network verification process also creates a list of identified members. [YouPost](#) is a New Zealand Post initiative that creates a digital postal network connecting business providers (companies like your banking, phone, insurance, and energy suppliers which have signed up to YouPost) and customers ('you'). YouPost 'delivers mail from your approved providers digitally'. All receivers of mail through YouPost will need to have a verified physical address and register their name before mail is delivered through the network.

Other opportunities may emerge through Better Public Services initiatives.

### *Issues*

None of the primary data sources are compulsory for the whole population. None provide an accurate count of the population at present. Each has serious under-coverage and over-coverage for population statistics purposes, and coverage varies by age and sex. Investigation would include the potential for modifying the administrative sources, and/or using a large coverage survey to adjust for coverage limitations.

The identity authentication initiatives are directed towards improving client service and are strongly privacy-centric and voluntary. A basic premise of RealMe and YouPost is that users have control over when it is used. There is no objective to collect data for a full population list. Timeframes before they reach a mature stage appear to be long. However, they do create underlying systems and accurate linkages between government databases that might, if taken up by a large proportion of the population, provide a basis for an administrative census. Legislation changes would be needed.

### Option 3: Linked administrative sources for statistical population list

Several existing administrative sources could be linked at unit record level to establish a list of the population. These linked data sources would be used to improve population coverage and to supply demographic (or other) variables or obtain up-to-date address information.

Population counts would be obtained from several sources, linked probabilistically. Demographic variables may come from several linked sources. A coverage survey, possibly large, would estimate any adjustments needed.

Socio-economic information could be obtained through many sources probabilistically linked to the established population list. A large-scale survey could be used to provide additional variables if this were justified.

#### *Existing data sources*

Tax data, or health data, are the main existing options to serve as a key data source that includes large sections of the population. Other sources that could be linked to improve coverage include education data, births, deaths, and international migration. Electoral roll may also be an option, depending on legal issues. Other supplementary sources could also be included (for example, benefits, drivers' licences, passports). Several variations can be investigated within this option.

Statistics NZ's [Integrated Data Infrastructure](#) (IDI) provides a test environment, with several data sources already linked to the Inland Revenue tax data, in a secure environment approved for statistical and research purposes.

#### *Emerging opportunities*

Similar to option 2, major initiatives are underway to improve the efficiency and effectiveness of public services by making better use of information. RealMe, the government online identity verification, is another source that could potentially be linked to other administrative sources, and includes some accurate linkages. Other opportunities may emerge through the Better Public Services programme. There is some potential that new government infrastructure initiatives may, in time, create highly accurate linkages between government data sources, and provide standards and frameworks for all major government databases.

#### *Issues*

Probabilistic linkage is a statistical technique used when there is no unique identifier present in both data sources. Probabilistic linking uses variables such as name, date of birth, and sex to determine the likelihood that two records from different files belong to the same person. In the absence of a unique identifier, the linking carried out by Statistics NZ is largely probabilistic, meaning that linkage errors compromise population estimates. The main impact of probabilistic linking is likely to be inflation of the population list, and new methodologies may be needed to counter this.

Contributing sources also include over-coverage for population statistics purposes, and certain groups are still likely to be missing from the combined administrative sources.

Investigation would include the potential for modifying the existing administrative sources. A large coverage survey may be needed.

The new government initiatives focus on improving service delivery and creating efficiency. There is no objective to collect data for a full population list. Coverage is likely to be inadequate and timeframes are expected to be long before they reach a mature stage. However these initiatives can in time be expected to have a high degree of authentication of people who use these services, together with up-to-date address and relevant demographic details. They create underlying systems and accurate linkages between government databases that might support an administrative census. Legislation changes would be needed.

## Option 4: Aggregate statistical model, using formal statistical methods

Formal statistical modelling techniques for using administrative data with partial information about the population are being developed to improve population estimates between censuses. The Bayesian modelling approach creates a formal statistical model using data sources at aggregate levels. It has the potential to increase the efficiency and transparency of the estimation process, and generates formal uncertainty measures.

Population counts with breakdowns by key demographic variables would be produced by the statistical model. A PES-type coverage survey does not work in this situation.

Socio-economic information could not be obtained through this model. A large-scale survey would be essential for any socio-economic information about small groups.

### *Issues*

It remains uncertain whether the model results would be sufficiently accurate over a long period. The current approach is to hold a census to periodically rebase population statistics. In the absence of a census, an appropriate type of coverage survey (or other method) would need to be developed. This option does not include dwelling counts at present.

## Option 5: Commercial and social media 'big data' sources

Potential examples include the following.

- United customer databases are a consolidation of consumer transaction data for market research purposes. A static population frame could be compiled from data from utilities and loyalty card issuers, and this could be overlaid with dynamic data from loyalty card and mobile phone transactions. Potential suppliers of a united customer database are market research companies entering into arrangements with utilities and loyalty card issuers.
- Social media platforms, such as Facebook, collect biographical details, reveal social networks, and monitor usage.
- Electronic transaction history could emerge from consolidation of electronic transaction records and these could be used to create a personal rating/value to support a financial identity authentication service. These data could be used to compile a dynamic population frame. Potential participants in such an initiative are the electronic payments platforms and payment card issuers.

Population counts: Methodologies for producing population counts would need to be developed.

Socio-economic information: It is unclear whether traditional socio-economic information could be obtained. A large-scale survey may be essential for socio-economic information about small groups.

*Issues*

These potential commercial and social media big data approaches have major limitations at present. They would require large research and development efforts that may be best undertaken by commercial organisations or highly developed search providers like Google.



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