

CONSTRUCTING A MAJOR SURVEY: OPERATIONAL PLANS AND ISSUES FOR CONTINUOUS MEASUREMENT

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INTRODUCTION

The need to know ourselves is a fundamental requirement for our democracy. Government that purports to be "representative" must have knowledge of those it represents. This is so fundamental to our way of thinking that the taking of a census was written into the Constitution. The decennial census has evolved over the last two hundred years into much more than merely the tool by which congressional seats are reapportioned among the states. It has become the main provider of the country's profile, with the information it collects written into legislation that affects everyone. But the census is only taken every ten years, and we are a rapidly changing nation, increasing in number by at least 1 million housing units and 2 million people every year. A snapshot of us once a decade is no longer sufficient to determine programmatic needs. We need a better way than extrapolation, especially for small areas, to know ourselves over the decade so that efficient use can be made of our most scarce resource--government funds. Continuous Measurement (CM) can provide the information critical to Federal and state program evaluation and formulation, as well as serve the needs of researchers and the private sector.

A successful Continuous Measurement program will depend on our ability to design and implement a monthly national sample survey large enough to produce reliable annual estimates of socio-economic characteristics for states and areas of 250,000 population or more, and annual rolling accumulated estimates for small geographic areas based on five years of data. Accomplishing this formidable task will require that monthly national samples of 400,000 housing units, decreasing to 250,000 housing units after 2001, be selected from a comprehensive, accurate, and constantly maintained list of all the nation's units--a Master Address File.

The design of the sample and data collection process for the housing unit and group quarters components of CM, as well as other special populations, will require quite different procedures. The housing unit component drives the overall design and produces the data--operational and demographic--on which the viability and benefits of a Continuous Measurement program will be judged.

This paper discusses some of the operational plans and issues related to the housing unit component of a Continuous Measurement program. It describes our initial understanding of the issues that have guided plans for the 1996 test of the entire CM system in selected

sites. A more comprehensive version of this paper that includes reference citations and data on which the assumptions have been based is available from the authors on request.

THE DATA COLLECTION DESIGN

Estimates equivalent to those produced by the decennial census sample from its long form questionnaire will be collected from the CM housing unit component in three phases--a self-response mailback phase, a telephone followup phase, and a personal visit followup phase. Each must be designed to maximize response to its data collection mode, and do so at an acceptable level of quality and cost. Each successive phase will be attempting to obtain information from a more difficult-to-reach and possibly more uncooperative segment of the population, with very different demographic and socio-economic characteristics.

The last three decennial censuses have relied heavily on the public to complete and return a census questionnaire by mail. However, a self-response phase is uncommon in the recurring demographic household survey environment, where most surveys conducted by the Census Bureau use a combination of personal and telephone interviewing, often in a computer-assisted mode. Continuous Measurement will attempt to wed the census mail experience and current survey experience with computer-assisted telephone and personal interviewing--CATI and CAPI, and do so in a way that reaps the benefits of each, and produces estimates based on the combined data.

ISSUES OF THE MAIL RESPONSE PHASE

The initial measure of success for the mail phase will be the mail response rate--the number of questionnaires returned from respondents expressed as a percent of the total unit addresses in sample. This rate will vary widely by area and be influenced by factors as diverse as the quality of the sampling frame addresses, the demographics of the households, and the design of the questionnaire. Every sample unit will be given the opportunity to respond by completing and mailing back a CM questionnaire. When we cannot mail directly to sample units because their area either lacks a house number/street name addressing system, or one exists but is not used by the post office for mail delivery, field representatives will deliver a questionnaire mailing package directly to the sample units. Self-response is by far the most cost-effective way to accomplish data collection.

What can a national Continuous Measurement mail survey taking place monthly without the benefit of the "census environment" expect to realize as a mail response rate? How can we maximize this response? Based on the of the Appeals and Long Form Experiment (ALFE) (Treat, 1993), it seems reasonable to assume that the CM mail survey phase will enumerate about 50 percent of the sample units. ALFE tested three different census long form designs, with national results ranging from 49 percent to 53 percent. These response results were obtained by mailing a prenotice letter, an initial questionnaire package, and a blanket reminder postcard to all sample units, followed by mailing a replacement questionnaire package to units not responding by a specified date. We plan to use this approach in our 1996 CM site-based test, to be held in two central cities and four additional counties over a 14-month period beginning this fall. In a national sample mailout over approximately the same time period, we will evaluate the individual impact of the prenotice and the reminder card on the overall mail response rate to determine their cost-effectiveness. We will monitor the extent to which mail returns arrive "late," after the nonresponse universe has been determined and subsequent phases of data collection have begun, to determine the optimum time to start the nonresponse followup phases.

Which households are the most likely to respond to the Continuous Measurement mailout? All mail response populations are, by definition, self-selecting. The extent and nature of their differences from those who choose not to respond to a mail request can be quite large, particularly when the task to be performed requires time and effort and the subject matter is eclectic. Those households that choose to cooperate with a Federal government request to provide wide-ranging detailed personal information through the mail are our most civic-minded households. We have every reason to expect that the households that cooperate in the mail phase of a Continuous Measurement survey will look very much like those that completed and returned the 1990 census long form.

The following profile of a Continuous Measurement mail response household is based on the characteristics of mail response and nonresponse long form households in the 1990 census:

Nearly three-fourths of mail response households may live in single-family homes, compared to about 60 percent of nonresponse households. Also, nearly three-fourths of the response households will own their own homes--around 18 percentage points higher than nonresponse ownership--with the median value of their property exceeding the value for the nonresponse households by about \$12,000. Persons in CM mail response households will probably more closely resemble the typical "nuclear" family than those in the

nonresponding households, with nearly half currently married, and with very few unrelated to the householder. A considerably smaller proportion of persons in the response universe than in the nonresponse universe will be nonwhite or hispanic, and the median age of the mail respondents is about 7 years higher than the median age for nonresponse persons.

The mail data collection phase of the CM survey must successfully reach and gain the cooperation of these kinds of households again. Toward that end, we have designed a long form questionnaire for testing in the 1996 CM test that simplifies the rostering, and reorganizes the questions more logically wherever possible to minimize the need for skip patterns. The questionnaire has 16 pages and includes space for only five persons. Mail response households with more than five people will be contacted by telephone to collect the information for the additional household members.

Once the mail phase of data collection is complete, the hard part begins...attempting to contact and gain the cooperation of the nonresponse segment of our sample, units whose occupants have twice rejected or ignored our request to complete and mail back the questionnaire.

ISSUES OF THE CATI NONRESPONSE FOLLOWUP PHASE

The telephone has been used only in a limited manner to collect census data, primarily to obtain information required but missing from mail response questionnaires. Telephoning for this purpose has worked quite well since self-respondents usually provide a phone number on the questionnaire when asked. Over 85 percent of the mail returns in 1990 included a phone number.

Surveys, however, have been making use of centralized CATI for over 10 years, most successfully in recurring surveys where the initial contact and interview are conducted during a personal visit to the sample unit by an interviewer, with permission then granted by the respondent to conduct subsequent interviews by telephone. More recently, Census Bureau CATI facilities have been asked to "look up" telephone numbers for addresses and persons for specific surveys, using either directory assistance or commercially available listings on CD-ROM.

For an address-based survey like CM, using the telephone to make initial contact with survey units or to follow up on mail nonresponse addresses requires that accurate telephone numbers be obtained for very specific unit addresses without the benefit of surnames. The target addresses must be found on a telephone number source list, and the address matching step must be done precisely. If an incorrect address match is made, the wrong telephone number will be provided, and the wrong unit contacted--a needless waste of resources, and a potential source of sampling bias if the interview is conducted.

How successful can we be in obtaining telephone numbers for the CM mail nonresponse units? The decennial area of the Census Bureau has recently completed telephone matching studies evaluating three commercial vendors (Wurdeman, 1995). A national sample of addresses, selected from the 1990 Address Control File (ACF) and mailed to during the decennial questionnaire design research studies, was matched to the files of three vendors. The overall results varied from 23 to 35 percent. A measure of "goodness" was obtained by calling a sample of the telephone numbers and verifying the contacted addresses. To be considered "good," an acquired number had to be a working voice line and make contact with the targeted address. These measures ranged from 75 to 89 percent of the acquired phone numbers.

To produce state estimates of commercially-available telephone numbers, and to study the characteristics of matched and unmatched addresses and their residents in more detail, the CM staff provided the addresses for housing units in the October 1994 Current Population Survey (CPS) to Telematch, the vendor with the highest decennial match rate. The correct phone number was known for over 80 percent of the CPS addresses since CATI interviews had recently been conducted with the households. The CPS phone numbers were compared with those provided by Telematch to produce a "goodness" measure.

Telematch provided phone numbers for over 35 percent of the CPS addresses, with an 80 percent "goodness" rate, comparable to the decennial results obtained with the ACF samples. Both results also illustrated a major problem with acquiring telephone numbers for units in multi-unit structures. All telephone number acquisition studies to date have shown that commercial sources are unable to identify and provide phone numbers for specific residences within multi-unit structures since apartment numbers are seldom present on their address records.

The Telematch-CPS results showed wide variation in acquisition rates between states, ranging from a low of only 13 percent in Alaska to a high of 47 percent in Iowa and Nebraska. Obviously our ability to obtain telephone numbers for specified addresses will differ greatly from area to area. The acquisition rate will be depend on both the address type and the prevalence of non-published numbers. Census Bureau research on telephone coverage concluded that between 20 and 30 percent of all households nationally have non-published phone numbers, with state estimates ranging from 4 percent in Iowa to over 40 percent in Hawaii (Kee, 1993).

It appears that an overall telephone number acquisition rate of about 35 percent will be easily obtainable from commercial vendors for the CM sample addresses. If we assume that between 20 and 30 percent of all the CM addresses are non-published, our acquisition

research should be focussed on the 35 to 45 percent of the addresses for which telephone numbers may be obtainable if we can find the right sources. We will be searching for viable sources of telephone numbers and testing various methods to supplement commercial acquisition for this "possible" group. Since addresses in multi-unit structures are a large segment of this group, the search will focus on administrative records that must maintain mailing addresses to which a periodically updated telephone number is appended.

The most obvious candidates are telephone company files used to generate bills, or phone service files that contain individual unit identification for location purposes. However, attempting to gain access to the business files of every telephone company is a daunting prospect. Another possibility for sample units located in large apartment buildings might be to obtain all commercial telephone numbers associated with the basic street address of the sample unit. Hopefully, we may reach the rental office for the apartment building and be able to obtain the occupant's surname, if not the telephone number. Knowing the surname may allow us to correctly identify the sample unit among the multiple phone numbers available from commercial vendors for these buildings.

Of the telephone numbers acquired, only those for addresses of mail nonresponse households will be of value. Unfortunately, all studies have indicated that obtaining good phone numbers for these households will be even more difficult than for the population as a whole. Decennial studies have shown that the telephone number acquisition rate for nonresponse addresses runs from 5 to 10 percentage points lower than the overall rate. Considering the characteristics of the long form households who did not respond by mail to the census we can speculate as to why this is so. Only 27 percent of the mail response households lived in apartments, mobile homes or some other type of unit. The mail nonresponse component looked quite different, with 40 percent of the households in these type of units. The disproportionate number of nonresponse households in multi-unit and other types of units whose unique apartment or lot numbers are not generally found on commercial phone number source lists may limit the followup cases that are referred to a CATI facility to at most one-fourth of the mail nonresponse universe.

How cooperative will these households be if we are able to reach them? The 1995 Census Test CATI nonresponse followup attempted to collect only short form information from contacted households. The success rate varied by test site from 44 to 62 percent. Based on these results our current hope is that we will complete CATI interviews with about 50 percent of the mail nonresponse units with which we make contact. For six months in 1994-1995, the CM staff conducted the first test of CATI collection of census long form information. An overall CATI interview rate of 65 percent was realized--a positive result for a first attempt

to conduct census long form interviews, especially since calls were placed without advance notice (Dawson et al, 1995). However, it is very unlikely that the CM CATI nonresponse followup data collection phase will approach this interview rate, when the CATI workload will consist only of households that did not respond to the self-response phase. The success of telephoning for long form mail nonresponse data collection will be determined during the full operational test of the CM design during 1996.

What will we do if the results of the CATI data collection phase are disappointing? The many uncertainties with this data collection phase make it difficult to predict a CATI nonresponse followup conversion rate. If the telephone number acquisition rate proves to be only 35 percent, with around 80 percent of the numbers capable of reaching the specific nonresponse sample unit and a CATI interview rate about 50 percent, an overall nonresponse conversion rate of about 14 percent could be expected. This is considerably lower than previous conversion assumptions (Alexander, 1993). Obviously, a concerted effort must be made to improve telephone number acquisition.

A worse-than-expected telephone acquisition rate will lead to higher costs than previously predicted, and may require changes in sample design that will increase the variance of CM estimates in order to avoid increasing the overall cost. At this time, however, we have not re-evaluated the basic operational design, but will reassess the CATI phase after the 1996 experience.

ISSUES OF THE PERSONAL VISIT CAPI NONRESPONSE FOLLOWUP PHASE

The personal visit data collection phase represents the final attempt to obtain survey information from the remaining nonresponse units in the CM sample. The universe will contain all mail nonresponse addresses for which we were unable to acquire a telephone number, as well as all that were not successfully reached and interviewed using the phone numbers we did obtain. This universe represents a very diverse group of sample units that will be the most difficult to enumerate for a wide variety of reasons.

Should the enumeration of sample units whose questionnaire is returned by the United States Postal Service be expedited? What will be the effect on vacancy rates if we do not do so? Collecting data for vacant units will make up a significant part of the CAPI personal visit phase. In the 1990 census, about 28 percent of the nonresponse followup workload consisted of vacant housing units. The insertion of a telephone nonresponse followup between the mail and personal visit data collection phases will increase this overall proportion even more for the CM personal visit universe. The overall design of the CM survey may result in a significant underrepresentation of vacant

units. The mail and telephone phases can only enumerate occupied members of the sample, thus allowing the sample units that were vacant during the two earlier phases to become occupied by the time a personal visit is made. The proportion of cases shifting from an occupied to vacant status will be much smaller.

A possible way of expediting the enumeration of sample units that may be vacant would be to use postal "failure to deliver" notices to define an early personal visit followup universe prior to defining the final CAPI followup universe. To do so, however, will probably prohibit mailing a replacement questionnaire package to the postmaster return (PMR) addresses. Experiences with successive first class mailings to identical addresses have shown that the PMR universe is extremely unstable. The trade-off would be between the chance to enumerate a sample unit by mail if it is occupied versus the chance to detect vacant units earlier in the data collection process in order to control the bias against them in later phases.

How could the CAPI followup operation be changed if the personal visit nonresponse universe is larger than expected? The original CM design (Alexander, 1993) was based on the assumption that only about 18 percent of occupied housing units, plus all the vacants, would remain to be interviewed after the mail and telephone phases. Accordingly, if these nonresponse units were subsampled at a rate of one in three, and possibly even less in remote areas, they would represent only a small fraction of the total CM sample. Therefore, the simple unclustered design which is most efficient for the mail mode was extended to the personal visit cases.

If the personal visit nonresponse universe is larger than expected--current estimates are as much as 42 percent of the total housing unit sample and 35 percent of the occupied units--alternative designs may need to be considered, most involving clustering, either in the original sample design or in the subsampling of nonresponse cases in the personal visit followup phase, to save on followup costs.

Design alternatives will be considered further as more information is available on CM costs and operational practicalities from the 1996 test of the basic tri-modal procedures.

ISSUES OF RESIDENCY--WHOM TO INCLUDE IN THE ESTIMATES

A fundamental decision must be made concerning whom to consider a "resident" of the CM sample unit. Rules determining residency should correspond to common-sense, as well as legal and political meanings of the terms "residence" and "household." There should be a practical way to accurately determine each person's residence and to assign his or her survey information appropriately, and each should have one and only place of residence at any point in time.

Should Continuous Measurement try to follow the decennial residence rules? The primary purpose of the decennial census is to produce a complete count of the population and to allocate everyone to the correct geography for apportionment. To this end, the census attempts to apply a set of rules that define a "usual residence" for everyone based generally on where a person lives or stays "most of the time," regardless of where he or she is actually staying when the census makes contact. A single date, "census day," is used as a reference for establishing the status and occupants of each unit. In situations where an individual is enumerated at a residence other than the "usual" one, a record-searching operation often attempts to assure that the person's data are assigned to the geography associated with the "usual" residence.

The Continuous Measurement survey will measure many of the same characteristics as the decennial long form sample, but will collect data throughout the year using a moving reference period. The continuous nature of CM data collection leads naturally to a more de facto approach than the census de jure rules require.

What is the most appropriate way to define residency and household membership when using a rolling sample to make "annual" or "annual average" estimates? The answer is a subject for research and consultation with potential users of the data. We believe a de facto approach that enumerates people where we find them is likely to be the most satisfactory. A pure de facto approach, however, would be problematic. For example, household composition--crucial for producing household income and other important measures, may be erroneously described if people who are clearly household members are away "temporarily" when data for the unit are collected. Since CM data collection for a given sample unit can occur any time during a period of up to three months, the actual timing cannot be readily controlled.

We propose, therefore, to exclude short stays at an address by people who have another more permanent residence. A modified de facto rule will be used during the 1996 CM test, and be evaluated by examining seasonal patterns, comparing various categories of residency to independently derived population estimates, and by possibly recontacting some households with unusual residence patterns.

The Proposed Residence Rule for the 1996 CM Test

The 1996 test residence rule establishes household membership and residency as of the date of contact with the sample unit. For the mail phase of data collection, this is the date on which the questionnaire is completed by a current occupant of the sample unit, and for the CATI or CAPI phases it is the date on which contact is made with either a current occupant of the unit or a respondent knowledgeable about the unit's status. The basic rule defines "current" residents of the sample unit

as everyone staying there who has no other residence, as well as everyone staying there for more than two months even if he or she has another residence.

This "two month rule" simplifies the task of rostering, and also should produce distributions that more accurately portray the characteristics of an area over time. For example, college students home for the summer would be included as members of their parents' household if the address was in sample during that period of time. People with more than one residence would be considered residents of the CM sample address if they are in residence when contacted and their stay is for more than two months. They would be reflected in the distributions for the area in which they were currently living. In annual estimates these "current" distributions would be averaged across the year.

The basic instruction is to include on the household roster everyone who is living or staying at a sample unit for more than two months. Exclusions are specified for someone who is temporarily away for more than two months, or someone who has another residence but is staying at the sample unit for two months or less.

The proposed rule differs from most survey residence rules as well as the census. Household surveys tend to apply some form of a de jure approach as of the month of interview, with modifications based on the target population for the survey. These surveys use personal or telephone interviewing rather than a self-response mail questionnaire, and therefore can implement fairly complex rules through interviewers' instructions. A modified de facto rule using a very short set of instructions is more suitable in a self-response mail environment. By avoiding a long list of whom to include and exclude, we hope to minimize the omission of people with no "usual" residence from household rosters. This might reduce the extent to which the CM survey will suffer from the population undercoverage considered to be higher in household surveys than in the census (Hainer, et al, 1988).

Under the "two month rule," what happens when everyone staying in a sample unit is there for two months or less and has another residence? Under the CM test proposal, a unit status of Temporarily Occupied will denote this situation. The survey will attempt to collect the housing characteristics of the sample unit from these temporary occupants, and to determine the existence of a more "usual" residence by asking about other residences and their location (state only) for all households.

ISSUES OF ESTIMATION AFFECTED BY THE OPERATIONAL DECISIONS

The structure of the CM survey introduces a large number of weighting and estimation issues that need to be addressed. Two of the issues are closely related to

the operational topics covered in this paper and will be briefly summarized here.

What role should mail and telephone status play in noninterview adjustment? At the end of the CM data collection operation, a certain number of personal visit nonresponse followup cases will be declared noninterviews, either because of outright refusal, or because of the inability of the interviewers to find the occupants at home. Some basic characteristics of these sample units will be available either from the MAF or from interviewers, recorded by observation or from information provided by neighbors. The characteristics include geographic location, units in structure, race, occupancy/vacancy status, and approximate household size.

In addition to the "traditional" noninterview adjustment variables available, CM will have two additional ones to consider--the month when the data were collected, and the response type, i.e., mail, telephone followup, or personal visit. As discussed earlier, mail response is related to many important demographic characteristics, and households that respond in this manner represent a very different subset of the population than do the nonresponse households.

Response-type variables have not been used previously in the weighting of decennial census samples or household surveys. Using a mail response variable in the weighting cell definition means that only the telephone and personal visit interview data would contribute to the noninterview adjustments. We propose to research its potential, initially using 1990 census data, followed by 1996 CM test data, possibly extending the empirical work to the nature of the telephone response households versus the personal visit ones.

What population controls should be used for CM estimates? The decennial census produces counts of the total population and housing, along with basic characteristics, that can be aggregated to any geographic level. Estimates of counts and characteristics from the census sample are made to agree with, i.e., "controlled to," these totals at the weighting level.

Sample surveys, by definition, only collect data from a subset of the population, and infer that estimates produced from the sample are also descriptive of the population not in sample. All Census Bureau household surveys control their estimates to independent estimates of the population, and some control to estimates of housing units as well. The independent estimates derived by the Census Bureau are available in considerable detail by age, race, gender, and Hispanic origin at the national level, in less detail at the state level, and at the county level even estimates of total population and housing are still experimental. The CM sample is being designed to ultimately produce estimates to the census tract and block group level, a level for which no controls exist save decennial census counts. The Bureau's demographic estimates staff are

researching ways to make more detailed estimates for the 1996 CM test areas.

The residence rules for producing traditional intercensal estimates are essentially those of the decennial census, but in practice are somewhat ambiguous. Birth and death records are often more de facto in nature, and geographic detail about migration is incomplete and requires that fairly strong assumptions be used.

An important issue for CM estimation is how to reflect the more seasonal CM de facto rules and its "two month rule" in the population controls. Several alternative approaches are being considered, most involving attempts to either reassign CM households to geography under a de-jure rule, to use CM information to adjust the independent estimates to a more de facto rule, or a combination of both approaches (Weidman et al 1995).

SUMMARY

Each aspect of the Continuous Measurement survey described here will be tested beginning this fall and throughout 1996, along with all support control systems, questionnaire data capture operations, and computer-assisted instruments. Estimates and public-use microfiles will be produced from the site data collected. The CM staff and other interested parties will be carefully monitoring and evaluating the process through each step, and results of the 1996 CM test will be instrumental in the final operational design of the program.

This paper reports the general results of research undertaken by Census Bureau staff. The views expressed are attributable to the authors and do not necessarily reflect those of the Census Bureau.