A PROTOTYPE
CONTINUOUS MEASUREMENT SYSTEM
FOR THE
U.S. CENSUS OF POPULATION AND HOUSING

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INTRODUCTION

The Census Bureau is considering a proposal which might replace
the traditional long form content sample in the 2000 census with
a "Continuous Measurement" (CM) program which would collect the
same information throughout the decade. The Continuous
Measurement system would consist of:

  i) an ongoing field operation to locate and update a sample of
     addresses from the Census Bureau's Master Address File
     (MAF), which is linked to the TIGER geographic database;

 ii) a large Intercensal Long Form (ILF) survey;

iii) a Program of Integrated Estimates (PIE) to combine data from
     the ILF, other household surveys such as the Current

Population Survey (CPS) and the Survey of Income and Program
Participation (SIPP), the previous census short form, and
demographic estimates derived from administrative sources,
to make small-area estimates.

Although the idea of "spreading out the census" has been
suggested at least since Eckler (1972), it began to be given more
serious attention after the 1990 census as discussed in Melnick
(1991), Subcommittee on Census and Population (1992), Sawyer
(1993).

The proposal draws heavily on ideas of Kish (1981, 1990) and a
previous Census Bureau proposal by Herriot, Bateman, and McCarthy
(1989), as well as estimation ideas suggested by Herriot and
Schneider (1990). The major development since these earlier
proposals is the availability of the MAF, which is already being
developed as a source of addresses for the 2000 Census.

This paper describes the prototype design being considered for
the CM system, the reasons for selecting it, and plans for
testing and evaluation of CM. Additional details of the design
are given in Alexander (1993), which includes additional
references.

COMPONENTS OF THE CONTINUOUS MEASUREMENT DESIGN

A sampling frame based on MAF/TIGER

The Census Bureau is currently developing a system to build and
keep up to date a national MAF. This will largely be in place by
1996, constructed by an ongoing computer match of U.S. Postal
Service mail delivery files with the 1990 census Address Control
File. These addresses will be linked to the TIGER geographical
database. Addresses not geocoded by the computer match will be
resolved clerically when possible, using resources such as
commercial maps, assistance of local governmental officials, and
additional information from the Postal Service and its letter
carriers.

The CM prototype would add to these plans an ongoing field
operation to locate MAF addresses that are in the ILF sample, and
check out any situations that cannot be resolved by the computer
and clerical operations. The MAF/TIGER files would be updated to
correct any errors or duplications found in using the frame for
the ILF and other current surveys, or by special Quality
Assurance samples. Additional updating would be conducted by ILF
interviewers when a block which needs updating is near a housing
unit being visited for the ILF. This new operation, called the
Sampling and Address-Correction Feedback Operation (SACFO) is
separate from the MAF/TIGER system, but interfaces with it.

The main uncertainty about this SACFO operation is the handling

of "rural-style" addresses, usually post office boxes or general delivery. We hope that by 1999 most of these addresses can be linked to a "city-style" address (house number, street name, apartment designation) used for Emergency 911 service, even when this address is not used for mail delivery. Respondents would be asked to write this geocodable physical address on the ILF questionnaire sent to their mailing address. The 2000 census form would also collect both addresses whenever possible.

The updated MAF/TIGER will be linked to a file containing data from the ILF, other household surveys, and the 2000 census. This will be used for the Program of Integrated Estimates described below.

The Intercensal Long Form (ILF) Survey

The ILF will mail questionnaires to about 250,000 addresses per month. The sample will be spread evenly across the MAF each month; i.e., the sample housing units will be spread evenly across the country. Each month's sample will be a separate set of housing units. Over five years the cumulative mail out sample size will be about 15,000,000 housing units.

Units that do not respond by mail, after several reminders, will be interviewed by telephone whenever the telephone number can be obtained from sources such as commercial lists or the previous census. Units that cannot be interviewed by mail or telephone will be designated for possible personal visit. Only a sample of these units will be sent out to be interviewed. The sub-sampling rate for personal visit units, including vacant units, will be 1 in 3 in most areas. A rate of about 1 in 5 will be used in remote areas. The total monthly interviewed sample size is expected to be about 200,000 units, including vacant units for which information is collected. This comes to about 12,000,000 interviews over a five-year period. (See Attachment A) This compares to about 14,500,000 interviews for the 1990 long form.

For the years 1999-2001, the monthly mail out will be about 400,000 per month, so that CM can start with small-area estimates based on three years of data.

In interpreting these sample sizes, it is necessary to take into account the weighting of the survey. The personal-visit cases will each be given a weight of 3 or 5 times the basic weight, according to their subsampling rate.   The weighted nonresponse rate for occupied units, corresponding to the portion of the population not represented by the survey because of nonresponse, is 7.5%. (See Attachment A)

The ILF will have larger standard errors than the 1990 long form for comparable estimates. Partly this is due to the small sample

size and partly to the need to use weighted estimates with some
units having much higher weights than others. Differential
weights increase the survey's variance compared to an equally
weighted sample of the same size. The overall effect is that
typical ILF standard errors will be 1.25 times as large as the
comparable 1990 long form standard error. Attachment B
illustrates this effect for estimates of the number of children
in poverty for various small areas.

This 25% increase in standard errors affects confidence intervals
about the same as going from a 95% to 90% level of confidence for
a given interval. This loss of precision would be worthwhile if
there are sufficient gains in data quality due to use of more
recent data, collected by better-trained interviewers.

The loss of precision would be greater for estimates of the
characteristics of vacant units or group quarters, which are
sampled at 1/3 the regular rate, or 1/5 in remote areas.

There also may be a loss of precision compared to the 1990 census
for places of under 2500 population with their own governmental
units. The 1990 census sampled such places, containing about
7.5% of the population, at a rate of 1 in 2. To make up for
this, the sample in large areas--tracts of over 4000 population--
had their sampling rate reduced to 1 in 8 rather than the usual 1
in 6. The CM proposal currently assumes a uniform sampling rate
everywhere. If the 2000 census content determination process
establishes a need for extra sample in certain areas, the CM
design will be modified to meet the same need. The legislative
requirements for the oversampling have not yet been well
documented; certainly the sudden cutoff at 2500 needs to be
evaluated.

The ILF sample size for individual tracts or other small areas
would be evaluated periodically. Areas with poor response rates,
or low rates of completion by mail and telephone, would have a
higher-than-average mail out sample size or personal-visit
follow-up rate. This would avoid some of the historical problems
with insufficient long-form data in some "hard-to-enumerate"
areas.

Compared to a one-time census, the smaller, permanent ILF
interviewer staff would be more selectively recruited, more
experienced, and more extensively trained and observed. This
seems likely to produce data of better quality, although
experimental evidence quantifying the effect is lacking.

The Program of Integrated Estimates

The first CM estimates will be derived solely from the ILF, using
conventional weighting and tabulation methods along the lines of
those of the 1990 long form sample or CPS. The estimate for a

specific block or tract will be based almost exclusively on ILF sample data from that block or tract, although some adjustments will be made based on comparisons of the sample units to the entire MAF. There will also be some form of adjustment of the estimates to agree with independently derived demographic estimates for states or counties. For more details, see Alexander and Wetrogan (1994).

After the 2000 census, the samples for the Census Bureau's current household surveys, CPS, SIPP, the National Health Interview Survey (NHIS), the National Crime Victimization Survey (NCVS), the American Housing Survey (AHS), and the Consumer Expenditure Surveys (CES), would use the MAF as a sampling frame. At this point, the linking of these data and ILF data to the previous census short form will make it much easier to get good synthetic estimates for characteristics measured by these surveys for medium-sized areas such as cities and groups of counties.

This methodology is particularly promising for estimates of income, poverty, and housing quality. For these characteristics the ILF questionnaire gives a crude measure of the phenomenon, which would be highly correlated with the more valid measure given by the other, smaller surveys. Information from the ILF could also be used to improve substate labor force estimates from the CPS; here the CPS information would dominate the estimates, and ILF data would be used to adjust for differences between the CPS sample and the complete population.

The ILF would also serve as a useful screening sample for rare subpopulations; this is especially important for NHIS. Using ILF this way depends on legislative changes, which would permit some sharing of addresses between the MAF system and other Federal activities.

The methods for publishing or releasing the CM estimates still need to be worked out; this is a top priority for the Census Bureau's new CM Development Staff. The general strategy will be to make available very detailed general-purpose files, so that users can tabulate these to make whatever estimates they need. The files will be compatible with one or more standard statistical packages. Likely possibilities are 1) tallies by block or block group for each month that can be summed to give estimates for any geographic area and any time period; 2) a file of individual household data, with identifying information and detailed geography suppressed to preserve confidentiality. These data files would be updated quarterly; we hope to have each quarter's processing complete six months after the end of the quarter.

Although users can examine annual data for small areas, estimates for areas as small as census tracts will be very imprecise unless at least five years worth of sample (three years for 1999-2001) are used in the estimates. For block groups, even five-year estimates will have large standard errors; traditional long-form estimates for these areas also have high standard errors (see Attachment B).

For larger areas, annual estimates would be of interest. For areas of 250,000 persons or more, sample sizes would be large enough to support analysis of annual data. Annual National estimates could be made with considerable demographic detail. However, annual estimates for the total population may not agree with estimates from special-purpose surveys like CPS Supplements or SIPP, because of differences in the questionnaires and interview mode.

RATIONALE FOR THE DESIGN

Our objective in selecting a CM design was to produce small-area (or small domain) estimates that are better overall than the corresponding small-area estimates from the traditional long-form design. The proposed CM design would produce an estimate corresponding to any estimate which can be produced from the traditional design, including estimates for small areas such as tracts, block groups, school districts, traffic analysis zones, etc., and small domains such as demographic subgroups comprising 0.1% of the population or less. The fundamental differences are:

> i) the CM estimate will be an average over a five-year period (three years for 1999-2001);

> ii) the five-year average will be updated annually;

> iii) the CM estimates will typically have a 25% higher standard error.

The overall quality of these small-domain estimates is the major uncertainty we must address in our research on CM. For large domains where annual estimates have adequate standard errors for analysis, the quality advantages of the CM design are much easier to demonstrate.

The case we intend to build for the overall better quality of CM small-domain estimates depends on three main hypotheses:

A)   an annually updated five-year moving average is better for almost all purposes than a once-a-decade point-in-time measurement;

B)   for the important uses of small-area data, the advantage in

A is sufficient to outweigh CM's increased standard errors;

C)   other differences in measurement error between CM and the long form have relatively small impact and have an overall neutral effect on the comparison.

Our proposed research is intended to support or refute these hypotheses. The next few sections will discuss what we now know about these quality issues, and present our general plans for tests, research, and consultation with users about the research results.

Besides quality, the second major issue is cost. In addition to direct savings from eliminating the long form, CM has the potential for savings in other Federal data collection programs. These will be discussed in a later section. Also, the improvements in MAF quality due to regular use of the list for the ILF throughout the decade may lead to savings in the address list operations prior to the 2010 census, beyond what MAF could save without SACFO.

We need further research to estimate the magnitude of these costs and savings with any degree of confidence. Some preliminary calculations for design purposes did suggest that, for the prototype sample size, there is some chance that the savings produced by CM over the entire Federal system could equal or exceed the cost of the CM operation. This was taken into account in proposing the design.

<div align="center">MEASUREMENT ERROR ISSUES</div>

There are a whole range of detailed measurement error comparisons between a continuous "Intercensal Long Form" and a traditional once-a-decade long form. Each system has advantages and disadvantages for small-area estimates. Right now there is not enough information to draw a conclusion about the net impact

on "total error"; we hope to shed light on some components of the error through research and testing over the next few years.

Probable Measurement Error Advantages of the ILF compared to a traditional long form

1.   Better training, observation, and evaluation of interviewers.

2.   Ability to conduct ongoing experiments to evaluate and improve questions and procedures.

3.   More uniform actual interviewed sample sizes for small areas, since problems in specific areas can be identified and corrected by increasing sample sizes or

assigning more effective interviewers.

4.   Greater opportunity to investigate and correct for
      errors in estimates identified by independent local
      sources.

5.   More uniform treatment of seasonal effects. This is
      especially important for places like seasonal resort
      areas. CM would be better for areas where April
      characteristics are not representative of the whole
      year, for example agricultural employment. However, it
      would be worse for characteristics where April is
      "representative" and some other months are not, such as
      educational activity.

6.   Use of variable reference period, eliminating the
      recall lag for long-form units interviewed long after
      census day.

<u>Probable Measurement Error Disadvantages of the ILF Compared
to a traditional long form</u>:

1.   Less complete coverage of housing units, compared to a
      survey done at census time.

2.   Possible problems of within-household undercoverage of
      persons compared to the number collected on census
      forms. Undercoverage relative to the census is
      observed in CPS and other surveys. However, this
      problem may not be as serious for the ILF, which will
      be a census-like survey using census-like roster rules
      and interview modes.

3.   Lack of exact short-form counts for the same time
      period as the survey, for use in controlling tract-
      level sample estimates to agree with the full
      population.

4.   Worse measurement of income, for interviews, which take
      place late in the year.

5.   Greater confusion about variable reference periods for
      questions, compared to a census with a fixed census
      day.

6.   Greater confusion about residence rules.

Most likely there will not be a single conclusion about the
measurement quality that applies to all characteristics. We
expect that CM will give more uniform quality, eliminating very
bad estimates for a few small areas. However, for some important
characteristics, such as income or numbers of people by age-race-

sex, the long form would give a more exact estimate as of census day than the ILF does for any given time period.

DISCUSSION OF FIVE-YEAR MOVING AVERAGES

The critical uncertainty about the adequacy of CM small-area estimates for small areas such as census tracts (or "Block Numbering Areas" where tracts are not defined) is whether rolling five-year cumulated estimates will meet the needs of data users. Our research and consultations with users are at a very early stage, but some preliminary conclusions can be drawn.

Our initial discussions with data users suggest that the idea of cumulative estimates takes some getting used to. The first reaction is inevitably to compare the five-year average to good annual estimates; clearly good annual estimates would be ideal. However, when these the comparison is made to a once a decade snapshot, we have so far not found many situations that obviously favor once a decade.

At a very simplest level, the situation is this. When small areas are very stable over time, a five-year average is as good a single number to describe a small area as an estimate at a single arbitrary point in time. When the characteristics of the area are changing dramatically, an estimate at a single point in time is very misleading. In this case, a single five-year average can also be misleading, but a time series of moving averages gives some information about the change.

The five-year average estimate needs to be supplemented by:

   i) some numerical measure of variability within the five years, which will signal that the estimate should not be accepted at face value;

  ii) the ability to display the five single-year estimates, with their standard errors, so that the nature of any extreme variation can be noted;

 iii) the ability to display seasonal patterns so that these can be noted.

Example 1:

         (Assume constant population size for simplicity)

                        Poverty Rate
                   Tract #1   Tract #2

          Year 1   25   5
          Year 2   20   10

	Tract #1	Tract #2
Year 3	15	15
Year 4	10	20
Year 5	<u>5</u>	<u>25</u>
Average	15	15

This kind of example has been cited by several critics as an unfavorable example for the five-year cumulation. The five-year average says the two tracts have equal poverty rates, but tract #2 currently has a much higher poverty rate. A supplemental display of annual estimates might reveal the trend, but the individual annual estimates are based on too small a sample to be trustworthy. The official measures, used for such purposes as allocating funds according to need, would be the five-year averages.

However, a one-time snapshot would give worse results overall. If Year 1 were the census year, then Tract #2 would be identified as having a very low poverty rate, with no indication that any change has occurred. If year 3 were the census year, the results would be the same as the five-year average, but with no indication of uncertainty. If year 4 or 5 were the census year, the data would not yet be published since it takes about two years to complete processing for the large one-time long form sample attached to the census. We expect the smaller, ongoing ILF to have about a six months processing lag; this expectation does need to be tested.

The big advantage of the moving average is that after year 6 there will be an update that will gradually reveal the high poverty rate in Tract #2, if it persists.

Example 1 (Continued)

	Poverty Rate	
	Tract #1	Tract #2
Year 2	20	10
Year 3	15	15
Year 4	10	20
Year 5	5	25
Year 6	<u>5</u>	<u>25</u>
Average	11	19

There are technical problems with cumulations that must be

solved, and at best will have only imperfect solutions. How are dollar amounts to be adjusted for inflation? How do we handle situations where blocks are split and it is hard to determine the correct block for units interviewed before the split? Changes in the boundaries of cities are simpler; past years' values for the current city boundaries can be calculated retroactively, but this is still a complication.

Another issue is whether the five-year averages would be population-weighted. For CM, population-weighted averages will be much more convenient computationally. For a rate, the population-weighted average would be

$$R^W = \overline{X}/\overline{N} = \sum_{i=1}^{60} R_i (N_i /60\overline{N})$$

where R_i = rate in month i
N_i = population in month i
X_i = numerator of rate in month i, and

$$\overline{X} = \sum_{i=1}^{60} X_i /60 \; and \; \overline{N} = \sum_{i=1}^{60} N_i /60.$$

The alternative unweighted rate is

$$R^u = \overline{R} = \sum_{i=1}^{60} R_i /60$$

To illustrate the difference, consider a small area where a large increase in population (families) in the middle of the five-year period dramatically increases the poverty rate

Example 2:

	N_i	R_i
months i = 1..,30	100	0
months i = 31,...,60	1000	.90

R^u = .45   and R^W = .818

The larger rate R^W in effect looks at the total number of "family-months" and determines what proportion were spent in poverty.

PLANS FOR CM RESEARCH
AND TESTING

The timing and objectives of proposed testing and development are
described in Attachment C. Our plan is to use the test results
to address the research issues as follows.

The 1994-95 Cumulative Estimates Simulation Project

For a few test areas we plan to create a simulated population on
the computer for the years 1980-1992. Housing units for the 1980
and 1990 census will be linked when possible. Simulated values
for intermediate years, and non-long-form households, will be
generated using probability distributions consistent with the
observed values. Transition probabilities for intermediate years
can be estimated from American Housing Survey sample households,
for which 1980 long form data are also available. For blocks
with large numbers of new units, we will try to determine when
the actual units were built.

With the simulated population, the sampling and estimation for
the ILF can be implemented. Also the 1980 and 1990 long form
sampling and weighting can be implemented and checked against
actual census estimates. It will then be possible to examine
various uses of long form estimates, see how these uses would be
affected by using CM estimates instead, and compare the results
to the "actual" population values at the time the data are used.

If funding permits, the simulation files will be made available
to interested users who wish to compare the CM and long form
estimates.

This part of the research will address the utility of five-year
moving averages, and the impact on estimates of not having tract-
level controls from the short form. We do not expect to address
measurement bias with this study, although some information may
be collected on the variability of small-area nonresponse rates
in the long form.

The simulated CM estimates give us a good opportunity to
illustrate the CM data delivery system. Some mock output files
will be produced and distributed to interested data users for
comments on their utility. This will not be a realistic test of
our ability to produce real data from the system quickly. The
data delivery system for the 1995 Questionnaire Test will be more
complete and realistic.

The 1995 Questionnaire Test

We plan to collect ILF information by telephone from November
1994 through December 1995, using a variable reference period.
We have not yet decided whether the test will be National or be

conducted in only a few test sites. The test will use a
questionnaire based on the 1990 long form, with any changes
needed because of the moving reference period. The questionnaire
would e revised once the 2000 census content determination is
complete.

A control group will be interviewed around April 1995 using a
fixed reference day. This will address our most serious
questionnaire concern, possible recall error in the reporting of
income late in the year. To help interpret any differences, a
comparative study is being considered of income estimates from
various existing household surveys using different reference
periods and interview times (CPS March Supplement, 1990 long
form, SIPP, CES, NCVS, etc., as well as some non-Census-Bureau
surveys).

This test will also be used as a trial of the data processing and
data delivery system. An initial version of the public data
files is tentatively scheduled for August 1995. Depending on
funding and staffing of the CM Development Staff, the initial
files may be fairly complete, or may be restricted to an
illustrative set of variables. These files will be made widely
available to interested data users; the mechanism for
distributing the files has not been worked out. The data
delivery system will be revised based on user comments, and
improved versions will be released during 1995 and 1996 as
necessary as response to the comments.

Additional test components to get at the effects of alternative
reference periods and seasonal variability will be considered.
This test will not address coverage. Some experience with
cumulative estimates as compared to a March or April long form
might be gained if some test areas overlap with the 1995 Census
Test areas; the merits of this are being discussed.

Some cost information relevant to the telephone interviewing and
data processing activities of the full CM system would be
collected.

The 1996 CM Operational Test

Starting in FY 1996, there will be a full-scale implementation of
CM in a few test areas, including at least one site with many
non-city-style addresses. The test sample will probably use a
sampling rate at least as large as the proposed 1999 system. We
are considering a larger sample rate to get more precise
estimates quickly. This test will give us more information on
cost parameters, by monitoring the workflow and cost of the test.

The test will also be used to evaluate CM's coverage of
households and persons within households. Our likely approach to
this is to apply coverage measurement procedures being developed

for the 1995 census test. We might actually be able to use 1995
census test final address lists to evaluate the CM list, if the
CM test uses some of the same sites.

The CM estimates will be studied to try to evaluate some
measurement errors, to confirm or further investigate findings of
the 1995 Questionnaire Test. This will involve looking at
variations in the CM monthly estimates, and comparing estimates
with other data sources.

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USES OF CM TO ENHANCE OTHER
PARTS OF THE FEDERAL STATISTICAL SYSTEM
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Even without any ILF, SACFO's coordination of address sampling
and updating activities and PIE's linking of data census for use
in estimation would have important benefits for the operations of
Current Household Surveys conducted by the Census Bureau. A
sampling operation based on MAF would be more flexible than the
current system based on listing building permits throughout the
decade in sample areas. Linking survey data to census data and
information from administrative records systems holds great
promise for small-area estimation and intercensal demographic
estimates. A small "mini-ILF", aimed only at collecting
information on areas which would be "outliers" in small-area
estimation models could dramatically improve the performance of
the estimation methods at relatively low cost.

The full-scale ILF would increase these benefits by providing a
larger number of address corrections and more direct information
for small-area modeling.

The ILF could also be used to screen for rare subpopulations or
characteristics, allowing programs that need to collect data for
small groups to reach these groups affordably. The ILF sample is
sufficiently large that the screening sample could be confined to
the same areas as the other surveys and still yield plenty of
cases.

For CM to be used as a screening survey for other Federal
programs, some changes in legislation are needed to allow sharing
of addresses among agencies. Most of the cost advantages of
screening for rare subpopulations could be obtained if the Census
Bureau could supply other statistical programs with a list of
addresses containing an oversample of units in the rare
subpopulation, even without supplying any data on the units.

We have just begun to contact Federal agencies to see how CM
might help them to achieve their mission more efficiently. Some
ideas, that at first glance seem technically realistic, are
listed below as examples of applications of CM besides direct
updating of long-form data.

Uses of small-area estimation methods

1. Use ILF or PIE data as covariates in ratio estimates to reduce the variance of CPS state or substate (large counties or cities) labor force estimates.

2. Use ILF or PIE small area data in combination with global income and poverty data from SIPP or the CPS March Supplement to produce synthetic estimates for small areas such as school districts.

3. Share sample units with the American Housing Survey, which has many questions in common with the long form housing questions.

Uses of ILF or MAF as a screening sample

1. Use ILF to screen for rare populations needed by NHIS to provide the detail needed to understand the causes of health patterns seen in aggregate data.

2. Use brief ILF supplemental questions to screen for units likely to have rare characteristics such as health conditions, residential alterations or, for NCVS, rare crimes such as abduction of children. Further information would be collected by followup interviews.

3. The MAF could be used to supply addresses of newly constructed units, for surveys of energy use or expenditures.

Besides benefits for existing programs, the full CM system provides the opportunity to meet new needs for data quickly and efficiently.

Uses for new topics

1. The MAF provides a ready sample to concentrate interviewing in any local area. With ILF in place, there would always be a current baseline of long form "background variables" for any geographical area defined in terms of whole blocks. This would allow a focused local survey to measure needs and rate of recovery for areas affected by natural disasters, such as floods, earthquakes, or hurricanes, or unusual economic or environmental events.

2. The ILF supplement could be used to provide National and subnational information on a variety of topics within the planned limits of 5-10 minutes worth of supplemental questions.

3. There may be efficiencies or opportunities to improve
    quality by coordinating MAF/TIGER and SACFO with the Census
    Bureau's systems for collecting information on building
    permits. Information on permits is used as a Leading
    Economic Indicator.

CONCLUSION: PROSPECTS FOR
CONTINUOUS MEASUREMENT

The testing plan outlined above has two purposes:

 i) begin the implementation of SACFO and PIE;

ii) provide the users of Federal statistics with the information
     to determine whether the benefits of the CM system are
     sufficiently compelling to justify a change from the time-
     tested long form design starting in 2000.

Some amount of work to develop SACFO and PIE is clearly
worthwhile. Census Bureau staff currently devote considerable
effort on disjoint systems for i) maintaining an address frame
for household surveys, ii) constructing a list of addresses for
the decennial census, iii) using administrative records for
demographic estimates. Using MAF for all three programs in a

coordinated way requires planning and coordination, but so far
seems to require very few additional operations. Instead, there
is an opportunity to eliminate redundant operations.

It is an ambitions research task to prove the feasibility and
value of CM in time for a decision about the 2000 census. If
users of long form data strongly prefer updated cumulative
estimates for the ILF system, this would be a reason to pursue
replacing the long form with the ILF in 2000. This is by no
means a foregone conclusion. Alternatively, if this comparison
is about even, but new uses of ILF as a source of screening
sample or modeling covariates are sufficiently compelling, that
would give us reason to go forward. Once the research has
determined the benefits of CM relative to a long form, the cost
of the system and the additional response burden of collecting
the additional information must be weighed against the benefits.
 An important goal of our research is to develop the details of
the CM operation and, through testing, to measure the cost.

Our general research timing would be to provide evidence about
whether CM is a superior source of data by the end of 1995. If
the results are positive, this would justify a tentative decision
to proceed with the system for 2000. Evidence on cost and

feasibility would be available by the end of 1996, at which time a final decision on "census" content is needed.

The remaining argument in favor of an early implementation of ILF is that eliminating the long form would simplify decennial census operations. However, there is no evidence that the long form is a distraction that interferes with the census count operation, so simplification by itself does not seem to justify a 2000 implementation of CM unless we can demonstrate benefits for data users. Our immediate goal is therefore to contact data users and professional organizations familiar with uses of census data, to obtain their assistance in evaluating our research plans and research results.

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Anticipated Breakdown
of Monthly ILF Sample Size

Occupied Units: 225,000

  Completed by mail   135,000
  Completed by telephone   50,400
  Eligible for personal visit (P.V.)   39,600
      Subsampled out   27,600
      Designated for P.V.   12,000
         P.V. Interview   6,886
         P.V. Noninterview   5,114

Vacant Units: 25,000

  Subsampled out   17,424
  Data collected by P.V.   7,576

Total Mailouts: 250,000

Total Interviews: Occupied = 135,000 + 50,400 + 6886 = 192,286
                    Vacant   = 7576
                    Total   = 199,862

Average subsampling rate = .85 x 3 + .15 x 5 = 3.3
  (assumes "remote areas" have 15% of population)

Weighted noninterview rate for occupied units =

$$\frac{5114 \; x \; 3.3}{135{,}000 + 50{,}400 + 6886 \; x \; 3.3 + 5114 \; x \; 3.3} = .075$$

Illustrative Comparison of Reliability Between Decennial Census and Continuous Measurement Data
Collection Systems for Areas in Maryland Percent of Children 5-17 in Poverty

Areas	Decennial Census			Intercensal Long Form (ILF)*	
	Population Size	Estimate	CV**	CV	
				12-month***	60-month****
Maryland					
State Total	4,781,468	10.5	1.1%	3.2%	1.45%
Baltimore City	736,014	31.3	1.5%	4.1%	1.8%
Anne Arundel County	427,239	5.3	5.6%	15.7%	7.0%
Carroll County	123,372	3.6	10.0%	32.3%	14.7%
St. Mary's County	75,974	9.4	9.2%	NA	11.9%
Gaithersburg	39,542	7.4	16.2%	NA	21.2%
Somerset County	23,440	15.6	14.0%	NA	18.3%
Kent County	17,842	12.9	14.9%	NA	22.4%
Hyattsville	13,864	5.6	25.8%	NA	35.1%
Havre de Grace	8,952	23.5	14.2%	NA	19.6%
Capitol Heights	3,633	7.2	46.5%	NA	61.7%
Cottage City Town	1,236	5.0	46.0%	NA	103.8%
Congressional Districts					
District 1	597,684	10.2	3.2%	9.1%	4.1%
District 2	597,683	6.3	4.2%	11.8%	5.3%
District 3	597,680	11.9	3.0%	8.4%	3.7%
District 4	597,690	8.0	3.6%	10.4%	4.6%
District 5	597,681	4.7	4.7%	13.9%	6.2%

District 6	597,688	8.3	3.5%	10.2%	4.6%
District 7	597,680	30.2	1.6%	4.7%	2.1%
District 8	597,682	4.1	5.2%	14.8%	6.6%

NA - Not Applicable

* Calculations of reliability for ILF estimates are based on: 1) a sample size 64% of that needed to provide reliability comparable with that from the decennial census and 2) no oversampling of governmental units under 2,500.

** The CV or coefficient of variation is a measure of sampling variability. The CV is the ratio of the standard error of a sample estimate to its expected value. There is no specific rule to determine if a given CV is good or not. This determination is based on considerations, such as use of the data, consequences of making the wrong decision, and so forth. In practice, a CV of 10% less is often considered to be adequate, between 10 and 50% to be acceptable, and 50% or more to be undesirable.

*** Estimates are based on weighted observations from 12 months of interviews.

**** Estimates are based on weighted observations from 60 months of interviews.

Attachment C

ACCELERATED MAF-BASED
CONTINUOUS MEASUREMENT
Data Collection Activities

FY	Data Collection Activity	Objectives
1994	Cumulative Estimates Simulation Project	o Demonstrate properties of Cumulative estimates. o Measure effect of population controls on estimates o Illustrate data delivery system.
1995	RDD Test with 2000/month total in 3-4 sites, starting November 1994. Convert to split-sample questionnaire test in July 1995. Small mail pretest.	o Test alternative versions of questionnaire o Measure effect on time of year and moving reference period on income data, etc. o Demonstrate ability to deliver timely data o Tentative decision regarding 2000 long form
1996	MAF-based test with at least 4000/month total in 4 sites, starting October 1995.	o Develop/test field procedures o Measure coverage of MAF/SACFO o Decision regarding 2000 long form
1997	MAF-based "development survey" for Congressional-District-level estimates, full speed in January 1997. Rural sample clustered in PSUs.	o Refine actual procedures o Produce annual estimates for areas of 500,000 or more o Final content determination
1998	Expand MAF-based sample size; change procedures and questionnaire to fix problems found in FY 1997. Better rural	o Further evaluation of quality o More annual estimates for areas of 500,000 or more

	spread.	o Phase-in full system
1999	Full MAF-based system. Complete rural spread.	o Collect small-area data to replace 2000 long form