UNITED STATES DEPARTMENT OF COMMERCE
Economics and Statistics Administration
U.S. Census Bureau
Washington, DC 20233-0001

May 29, 2012

2010 CENSUS PLANNING MEMORANDA SERIES

No. 197

MEMORANDUM FOR   The Distribution List

From: Arnold Jackson *[signed]*
                                         Acting Chief, Decennial Management Division

Subject: 2010 Census Coverage Followup Assessment Report

Attached is the 2010 Census Coverage Followup Assessment Report. The Quality Process for the 2010 Census Test Evaluations, Experiments, and Assessments was applied to the methodology development and review process. The report is sound and appropriate for completeness and accuracy.

If you have any questions about this document, please contact Kelly Govern at (301) 763-9279 or Julia Coombs at (301) 763-5747.

Attachment

2010 Census
Coverage Followup Assessment Report

U.S. Census Bureau standards and quality process procedures were applied throughout the creation of this report.

Kelly Govern, Julia Coombs, and Robert Glorioso

Decennial Statistical Studies Division, Decennial Management Division

This page intentionally left blank

Table of Contents

List of Tables

List of Figures

This page intentionally left blank

Executive Summary

Ensuring that every person in the United States is counted once, only once, and in the right place is a vital goal of the decennial census. For many decades, the U.S Census Bureau has evaluated coverage in each census and documented that people are typically missed in the census. These people are referred to as census omissions. The Census Bureau has also documented that people are counted in the wrong place and found evidence that people are counted more than once during the census. Both of these errors are referred to as erroneous enumerations.

During the Coverage Followup operation, telephone interviews were conducted with certain respondents to determine if changes should be made to their household roster as reported on their initial census return. The questions asked during the telephone interview probed to identify if people were missed or counted in error, and to collect missing demographic data for all persons in the household.

The purpose of this assessment is to document many aspects of the Coverage Followup operation. It looks at the cases selected for the operation, documents the success at completing cases, describes the households with roster changes, and profiles the persons added to or deleted from household rosters.

Data in this report may not match data in other Coverage Followup reports due to differences in various data sources. Caution is advised when directly comparing numbers between Coverage Followup reports.

What was the Coverage Followup Workload and how was it distributed?

There were an unduplicated total of 8,230,456 returns selected for Coverage Followup interviews during the 2010 Census. The Coverage Followup workload was distributed as follows:

- There were a total of 1,442,575 large household returns selected for Coverage Followup interviews.

- There were 1,312,165 returns selected where the number of valid people listed on the form was greater than the provided population count and 708,610 returns where the number of valid people listed on the form was less than the provided population count.

- There were 2,484,510 returns with an eligible response to the overcount question selected.

- There were 2,365,615 returns with an eligible response to the undercount question selected.

- 641,425 returns were selected for Coverage Followup that had at least one person who matched between an administrative record and the census return for that housing unit and at least one person identified on the administrative record but not on the census return.

- There were 448,808 evaluation, unduplication, and research returns selected for Coverage Followup, but not included as part of the production workload.

- Respondent-provided form types accounted for 85.9 percent of the production workload selected. These form types include: Mailout/Mailback – English, Mailout/Mailback – Bilingual, Mailout/Mailback – Fulfillment, Update/Leave – Stateside, and Update/Leave – Puerto Rico.

- Enumerator-provided form types accounted for 14.1 percent of the production workload selected. These form types include: Telephone Questionnaire Assistance, Nonresponse Followup, and Update/Enumerate.

A total of 8,053,052 returns were sent to Decennial Response Integration System for a Coverage Followup Interview in multiple scheduled deliveries of cases called waves. The majority of the 176,198 returns not sent, 67.3 percent, were returns from housing units that had already been sent to Coverage Followup in a previous wave. Of the production and non-production returns sent to DRIS, 60.4 percent completed an interview.

Were there problems creating the Coverage Followup workload and loading it into the dialer? If so, how can they be addressed?

- Additional testing may have mitigated a misunderstanding about the creation of the Data Capture Audit and Resolution Coverage Followup valid person flag as well as the exclusion of some enumerator forms from the selected universe.

- Group Quarters or Group Quarters-like facilities that were on the address list as Housing Units and included in the Coverage Followup workload created problems within the interview.

How effective was the dialer? How effective was the Coverage Followup operation at conducting an interview?

- While loading the sent cases into the dialer, 680,993 cases failed verification, mainly due to an invalid phone number or no phone number.

- A total of 7,372,087 cases were loaded in the dialer.

- There were 45,145,974 total dial attempts and 17,605,691 total connects.

- A total of 4,865,612 cases loaded in the dialer completed an interview for a 66.0 percent completion rate. Of these completions, 71.6 percent occurred on an outbound call and 28.4 percent were on an inbound call.

To what extent did the Coverage Followup operation improve coverage?

There were a total of 4,536,636 completed production cases. Of the completed cases:

- Overall, 27.1 percent of cases added or deleted at least one person on the household roster. Of the completed cases, 5.4 percent added a person to the household roster and 22.2 percent deleted a person from the household roster. A total of 350,901 persons were added to household rosters and 1,235,096 persons were deleted from household rosters.

- 897,735 large household cases were completed. Of the completed cases, 11.7 percent added or deleted a roster member; 38,474 cases added at least one person to the roster (for a total of 65,259 people), and 71,028 cases deleted at least one roster member (for a total of 121,477 deleted people).

- 778,642 cases where the number of valid people listed on the form was greater than the provided population count were completed. Of the completed cases, 34.4 percent added or deleted a roster member; 21,435 cases added at least one person to the roster (for a total of 28,607 people), and 252,115 cases deleted at least one roster member (for a total of 326,754 people).

- 287,740 cases where the number of valid people listed on the form was less than the provided population count were completed. Of the completed cases, 35.8 percent added or deleted a roster member; 89,670 cases added at least one person to the roster (for a total of 143,075 people), and 16,326 cases deleted at least one roster member (for a total of 21,711 people).

- 1,350,368 cases with an eligible response to the overcount question were completed. Of the completed cases, 19.2 percent added or deleted a roster member; 105,002 cases added at least one person to the roster (for a total of 138,669 people), and 163,073 cases deleted at least one roster member (for a total of 204,629 people).

- 1,534,063 cases with an eligible response to the undercount question were completed. Of the completed cases, 48.9 percent added or deleted a roster member; 26,654 cases added at least one person to the roster (for a total of 34,393 people), and 735,062 cases deleted at least one roster member (for a total of 863,406 people).

- 391,637 cases where at least one person was matched between an administrative record and the census return for that housing unit and at least one person was identified on the administrative record but not on the census return were completed. Of the completed cases, 7.8 percent added or deleted a roster member; 16,086 cases added at least one person to the roster (for at total of 28,219 people), and 15,738 cases deleted at least one roster member (for a total of 19,766 people).

The add and delete rates by the reasons a case could be sent to CFU met expectations from intercensal tests.

What were the results of the Coverage Followup Service Quality Assurance operation by call center?

The overall Service Quality Assurance score was 99.0 percent.

- Service Quality scores by call center were close to the average and ranged from 98.6 percent at Kennesaw, Georgia to 99.3 percent at Denver, Colorado, and Stockton, California.

- All critical criteria were scored at or above an average of 99.0 percent except for "Read Scripts Verbatim", which was scored at an average of 95.4 percent. This confirmed anecdotal observations.

- Universal criteria average scores ranged from 96.9 percent for "Effectively and efficiently navigate systems" to 98.3 percent for "Display enthusiasm and confidence".

- Of the 559,639 calls scored, 156 calls had a code of conduct failure, which were serious interviewer infractions including releasing Title 13 data, disconnecting the call, and speaking profanities at the respondent.

What were the results of the Coverage Followup Data Quality operation by call center?

In the Data Quality operation, 11,583 calls were scored, and the overall Data Quality score of scored calls was 0.994.

- Data Quality scores by call center were close to the average and ranged from 0.988 at Monticello, Kentucky, and one Sandy, Utah, call center, to 0.998 at Ogden, Utah, and Stockton, California.

- The critical questions showed average scores of at least 0.963, except for "Name of unrecognized roster member," which had an average score of 0.874. This confirmed anecdotal observations.

How costly were these improvements?

- The total Coverage Followup cost was an estimated $353,788,000, which was 4.3 percent under budget. The total Coverage Followup operational cost, including all production and non-production cases, was an estimated $202,161,000, which was 5.0 percent under budget.

- Dividing the operational cost by the Coverage Followup workload gives a cost of $25.10 per case. Dividing the operational cost by the number of roster changes gives a cost of $123.80 per roster change.

Were there problems administering the Coverage Followup interview? How can these problems be addressed?

The administration of the Coverage Followup interview was generally quite successful. Some problems were identified, and they are recorded here so that any future operation can continue to improve.

- Multiple rounds of testing caught and resolved many issues, but some testing relied too heavily on the DRIS development team. Some additional usability testing would have further improved the instrument.

- The progressive dialer functioned as expected, but complex levels of interviewer grouping by language, call direction, and ability to handle refusals were not available in the 2010 Coverage Followup operation.

- Call center selection did not match the telephony structure planned, and some adjustments had to be made. The geographic spread of the call centers was a success.

- The Coverage Followup operation was staffed under planned levels due to a lower than expected workload.

- Training was successful and efficient. The communications that continued to be released were useful in keeping the staff knowledgeable about areas of concern.

- Interviewers quickly learned to use the Coverage Followup instrument, but some challenging situations could have been overcome with more testing. Most of the instrument's functionalities were appreciated, but a few others were suggested by interviewers and contractors for future inclusion.

- On-site technical support was helpful to interviewers, but late planning in the help desk structures led to the use of existing processes instead of a fully customized solution, which limited flexibility.

- The capacity management team handled changes in workload volume well and was an overall success.

- Most trouble tickets were of low severity.

- Multiple data sources and data definitions made reporting difficult.

- An increase in positive publicity about the Coverage Followup program may increase response rates in future followup operations.

- The quality operations were successful, but better planning and scorecard tweaks could make them even better.

- Seven change requests were submitted and approved.

- The Coverage Followup operation stayed on schedule.

What conclusions and recommendations can be made for future Coverage Followup operations?

- The overall completion rate, the number of added or deleted people, the fact that the operation completed under budget, and the absence of any major operational complications indicates that the 2010 Coverage Followup was a success.

- Better workload estimates should be generated in the future.

- Better dialer data are needed for in-depth dial analysis.

- The effectiveness of the use of administrative records needs to continue to be assessed.

- Both quality operations worked well but could potentially be combined into one.

- Some additional instrument functionality could be added to ease interviewers' tasks.

- While not a main reason for case selection, the operation was effective at improving demographic item non-response.

1. Introduction

1.1   Scope

The purpose of the Coverage Followup (CFU) Assessment is to document the results and major findings of the 2010 CFU, including topics such as workload, dialer operations, outcome, quality evaluation, cost, and lessons learned. This assessment will inform stakeholders and decision makers of recommended changes or improvements for future censuses.

1.2   Intended Audience

This document assumes that the reader has at least a basic understanding of CFU. The goal is to use this document to help research, planning, and development teams in planning the 2020 Census. To gain a basic understanding of CFU, please refer to the Census 2010 Informational Memorandum No. 21, the 2010 Census Detailed Operations System Plan (DOSP) for Coverage Followup Operations. The DOSP is a document that describes CFU in more detail.

2. Background

2.1   Evolution of CFU within the Last Decade

Census 2000 included a Coverage Edit Followup (CEFU) operation, following recommendations from Census 1990. The CEFU was a telephone operation used to improve within-household coverage and data quality in two ways. First, it collected person data for household members beyond the first six fully captured on the Mailout/Mailback (MO/MB) census form. Second, it resolved count discrepancies between the reported household population count and the actual number of data-defined persons[1] recorded on the census form. Since enumerators were expected to resolve any issues at the time of the enumeration, no followup was conducted for enumerator-provided returns.

Throughout the decade, research was conducted on ways to improve coverage. These approaches included the addition of both overcount and undercount coverage probes on returns, the use of improved residence rule instructions on mail returns, the use of administrative records, and the investigation into count discrepancies from enumerator-filled forms. In addition, a followup field operation was tested when a household could not be reached via the telephone.

---

[1] A person was considered data-defined if the person record had valid entries for at least two demographic items.

Since Census 2000, there were four census tests that included similar coverage-related operations that attempted to improve coverage[2].

During these tests, the Census Bureau researched different types of coverage cases including:

- Large Households (LHH) – Housing unit (HU) returns that could not collect all of the person data due to space limitations of the form.

- Count Discrepancies (CD) – HU returns in which the number of persons listed on the form did not match the population count provided by the respondent or enumerator.

- Coverage Probes (CP) –Variations of the coverage probes were tested as part of the 2005 National Census Test. The undercount and overcount questions below are the 2010 Census versions.

  o Undercount Coverage Probe – HU returns that indicated, at a household level, that there were additional people staying at the household who were not included in the household population count box. See Figure 1 for the question wording.

Figure 1: Undercount Coverage Probe

  o Overcount Coverage Probe – HU returns that reported, at a person level, that at least one person sometimes lives or stays elsewhere. See Figure 2 for the question wording.

Figure 2: Overcount Coverage Probe

---

[2] These operations were Coverage Research Followup (CRFU) in the 2004 Census Test, CFU in the 2005 National Census Test, CFU in the 2006 Census Test, and CFU in the 2008 Dress Rehearsal.

- Administrative Records (AR) – HU returns that were potentially missing household members based on a comparison of the household roster from an administrative record with the household roster from a Census return.

CFU was tested by conducting interviews over the telephone and by personal visit. Most cases were sent to telephone centers for interviewing first, but some were immediately sent to the field for personal interviews[3].

Highlights and research goals from each of these operations were:

- 2004 Coverage Research Followup (CRFU)
  - The operation was conducted as part of the 2004 Census Test.
  - Interviews were conducted at telephone centers and by personal visit when telephone interviews were unsuccessful. Both interview modes used a paper questionnaire.
  - The operation tested how coverage probes affect within-household coverage.
  - The results revealed more about where persons with multiple residences prefer to be counted, which one they consider their primary residence, and how this relates to the Residence Rules about where they should be counted.
  - For a more in-depth analysis, please see Krejsa et al (2005) and Pennington (2005).

- 2005 CFU
  - The operation was conducted as part of the 2005 National Census Test.
  - Interviews were conducted by only telephone using an automated instrument for the first time since the 2000 CEFU.
  - The operation tested respondents' usage of six variations of the Residence Instructions included on the Mailback questionnaire.
  - The operation tested two different versions of the coverage probes.
  - For a more in-depth analysis, please see Sheppard et al (2007).

- 2006 CFU
  - The operation was conducted as part of the 2006 Census Test.
  - The operation tested the effectiveness of methods to improve within-household coverage on an American Indian reservation.
  - The operation tested the operational feasibility of including all sources that indicate a possible coverage error in one seamless processing flow.
  - Interviews were conducted at telephone centers using an automated instrument and by personal visit interviews using paper questionnaires when telephone interviews were unsuccessful.
  - For a more in-depth analysis, please see Krejsa et al (2007) and King (2007).

- 2008 CFU
  - The operation was conducted as part of the 2008 Census Dress Rehearsal.
  - The operation tested the effectiveness of using an automated dialer strategy.

---

[3] In the 2004 and 2006 Census Tests, cases without valid telephone numbers or cases that only had location descriptions for addresses were sent straight to the field.

- o Interviews were conducted at a telephone center using an automated instrument developed by the Decennial Response Integration System (DRIS) contractor.
- o A Nonresponse Followup operation was not tested in the 2008 Census Dress Rehearsal; cases in the 2008 CFU Dress Rehearsal were all from Mailout/Mailback returns, so the 2008 CFU was primarily a systems test.
- o For a more in-depth analysis, please see Govern et al (2009).

2.2 2010 Coverage Followup

2.2.1 Coverage Followup Universe

The 2010 CFU universe consisted of responses from the following initial census returns: Mailout/Mailback (including Bilingual, replacement mailings, Fulfillment, and Experimental), Update/Leave (U/L), Enumerator Questionnaires[4], and Telephone Questionnaire Assistance (TQA) interviews. All responses in the eligible universe were in the Universe Control and Management System (UCM), had a Census ID[5], had a Master Address File Identification (MAFID), and were nonblank forms that had sufficient information for a CFU interview (i.e., there was a last name on the form and at least one valid person with a name or age). For complete details of the eligible universe definitions, please see Kostanich (2009a). In addition, cases in the eligible universe had to have at least one source of coverage improvement, which are discussed below.

While the mid-decade tests provided an opportunity to research numerous expansions to the CFU operation, it would have been impossible for all aspects to be included in the 2010 Census due to budget and telephony infrastructure constraints. As shown in the 2006 Census Test Evaluation by Krejsa et al (2007), personal visit interviews for CFU did not correct the household roster as often as phone interviews did. With the personal visits nearly five times as expensive as the phone interviews, the 2010 CFU was conducted exclusively by telephone because it was the best method to maximize the number of cases in CFU (Chapin, 2007). In addition to analyzing the mode in which to conduct CFU, the types of CFU cases also were analyzed and limited for inclusion in the 2010 CFU operation. Two of the case types, large households and count discrepancies, were included in the 2010 CFU just as they were included in Census 2000. The remaining possible case types were examined based on maximizing the number of corrections – the sum of the number of people added to the initial household roster and the number of people deleted from the initial household roster – that could be made for the available funds and sorted

---

[4] Includes Nonresponse Followup, Nonresponse Followup Reinterview, Nonresponse Followup Vacant Delete Check, Nonresponse Followup Vacant Delete Check Reinterview, Nonresponse Followup Residual, Update/Enumerate, Update/Enumerate Reinterview, Remote Alaska, and Remote Update/Enumerate returns

[5] A Census ID is a unique number assigned for each living quarters in the census universe. Census IDs for the 2010 Decennial Census were fourteen digit numbers, incorporating the nine-digit MAFID, indicators for living quarter type (housing unit or group quarters), data capture priority, Type of Enumeration Area, and check digits. Census IDs were assigned by UCM, the system responsible for controlling and tracking the enumeration of the census universe. For more information, please see

as such. Case types, or sources of coverage improvement, a term not meant to imply that each case showed "improvement" by any measure, were then deemed eligible for the CFU operation if their inclusion kept the cumulative estimated cost below the budget constraint based on estimates of workloads for each case type. Note that all cases with the selected case type had to fit within the budget; that is, once a case type was selected, the entire workload had to be included in CFU and interviews were to be attempted on each case. Further detail on the selection of case types to be included in CFU can be found in Poehler (2010a).

The following sources of coverage improvement were included as production case types in the 2010 CFU operation:

- Large Households (LHH) - cases where the respondent-provided population count was equal to or greater than the number of possible complete person records for that form type. For example, the English Mailout/Mailback return could collect complete demographic information for six household members as well as abbreviated demographic information for six additional household members. A Mailout/Mailback return with a respondent-provided population count of six or more would be included in the CFU universe as a case with LHH as a source of coverage improvement.
- Count Discrepancies (CD):
  - High Count Discrepancy – cases where the number of valid people listed on the form was greater than the provided population count.
  - Low Count Discrepancy – cases were the number of valid people on the form was less than the provided population count.
- Overcount Coverage Probe – "In College Housing" category only
- Overcount Coverage Probe – "In a Nursing Home" category only
- Overcount Coverage Probe – "In Jail or Prison" category only
- Overcount Coverage Probe – "In the Military" category only
- Overcount Coverage Probe – "Household Multiple," where multiple people on one return marked different overcount categories
- Administrative Records cases - cases where at least one person was matched between an administrative record and the census return for that housing unit and at least one person was identified on the administrative record but not on the census return.
- Undercount Coverage Probe – "People staying here temporarily" category only
- Undercount Coverage Probe – "Relatives, such as adult children, cousins or in-laws" category only
- Undercount Coverage Probe – "Children, such as newborn babies or foster children" category only
- Overcount Coverage Probe – "Person Multiple," where at least one person on the return marked more than one overcount category
- Undercount Coverage Probe – "Nonrelatives, such as roommates or live-in babysitters" category only

These sources of coverage improvement are called production sources because changes to these cases with these sources of coverage improvement during the CFU interview could change the makeup of the household in the final census count. Low count discrepancy, undercount, and AR cases were selected because they indicated that persons may have been omitted from the return.

High count discrepancy and overcount cases were selected because they indicated that persons may have been erroneously enumerated on a return. LHH cases were selected to collect the demographic information that was unable to be collected on the initial questionnaire due to space limitations, although past research has also shown that these cases often contain omissions and erroneous enumerations as well. Further detail on the research involving LHH cases can be found in Alberti (1999).

During the operation, the workload was enlarged based on the high productivity of interviewers and on actual workload deliveries that were smaller than workload estimates. The cases in the undercount – children, overcount – person multiple, and undercount – nonrelatives categories had initially been created as contingency cases and were added when the workload was increased during production. In addition, the sampled rates of administrative records cases and evaluation cases were increased. Evaluation cases were case types that mid-decade testing suggested were not as likely to produce roster changes. Cases that had evaluation case types and no production case types were sampled for the 2010 CFU operation and their CFU returns did not affect residency statuses or census counts. For more information on non-production CFU case types, see Stewart (2010a) and Heimel (2010).

2.2.2 Headquarters Processing

Preparing the 2010 CFU universe was an iterative process that took place over 11 waves, as shown in Table 1. This process minimized the time between the completion of the original return and the CFU interview, which in turn minimized any recall bias. As census returns came in, the Universal Response Database Schema (URdbS) was populated with the collected data. During all waves of CFU case selection, the Decennial Systems and Processing Office (DSPO) identified and selected all cases that met the criteria for CD, LHH, and CP components. Cases were arranged into unique groupings by source of coverage improvement called buckets, which allowed control over what case types were available for dialing during the operation. During later waves of processing, DSPO made the URdbS available so that the Center for Administrative Records and Research Application (CARRA) could identify AR cases.

As a result of selecting the CFU eligible universe, multiple eligible responses existed for individual housing units. DSPO used the remove overlap processing system to select a primary response per housing unit. The remove overlap processing system included valid person and address checks. If a response passed the valid person and address checks, and had only one production response for a housing unit, then the response was considered the primary production response. If multiple valid production responses were present for a housing unit, then a response hierarchy was used to determine which response would represent the housing unit (Kostanich, 2009b).

The selected cases were then identified in the Universal Enumeration and Control Table (UECT) and made available to DRIS so that they could obtain the prescribed case data to administer the CFU interview. The UECT allowed DRIS to use the unique identifier contained in the UECT to pull the appropriate case from the DRIS copy of the data instead of requiring headquarters processing (HQP) to send every data point to DRIS. The case data pulled from the UECT was all information collected in the initial enumeration so that the interview could be populated with known data (e.g., names, ages, addresses) and so that any missing information could be gathered

in the interview. When the CFU interview was completed, DSPO applied residence codes to each person on the returns to establish the residency status for each person.

Table 1: Date Waves Sent to DRIS

Wave	Date Sent to DRIS
1	4/7/2010
2	4/14/2010
3	4/21/2010
4	4/28/2010
5	5/5/2010
6	5/12/2010
7	5/19/2010
8	6/9/2010
9	6/30/2010
10	7/14/2010
11	7/28/2010

Source: Phase III Deliverables

2.2.3   Data Response Integrated Systems

The management of the 2010 CFU telephony operations was contracted out as part of the DRIS contract, as it was for the 2008 Census Dress Rehearsal. Once the CFU case selection was made available to DRIS via the UECT, Workflow Control and Management (WCM) first put the cases through the CFU Verification process. During CFU Verification, cases with invalid telephone number lengths, invalid area codes, invalid prefixes, proxy responses, or other data errors were removed from the workload. WCM then performed a telephone lookup operation, which validated the phone numbers provided on the initial census returns—or identified a phone number if none was provided—and appended up to three phone numbers for each housing unit that provided no phone number or an invalid phone number. WCM also determined the initial CFU interview language based on the initial census return. In short, if the initial census return was in one of the languages in which CFU was conducted (English, Spanish, Chinese, Korean, Russian, and Vietnamese), that language was defined as the initial CFU interview language. If the return was an Enumerator Questionnaire, then the initial interview language was dependent upon the language in which the majority of the interview was conducted, as noted by the interviewer. Otherwise, the initial CFU interview language defaulted to English. WCM then passed all CFU cases to the telephony channel.

The telephony channel then processed the case list and created dialer lists. To account for phone number portability, a respondent's time zone was determined using the address zip code. Since a case's appropriate call times were set based on time zone, this method of determining a case's time zone was continually monitored during operations.

Once an interviewer became available to conduct an interview, the dialer began dialing. One requirement of the automated dialer was that it would not use predictive dialing. Predictive dialers use statistical algorithms to minimize the time that interviewers spend waiting between

phone calls in an attempt to minimize the occurrence of a respondent answering when no interviewer is available. So, for example, if one of ten calls is expected to be answered, a predictive dialer could dial five phone numbers for every interviewer who is available. The Census Bureau had concerns about using this solution, so a progressive dialer was used instead. A progressive dialer dials only one phone number for each available interviewer.

If a respondent was available, then the dialer connected the respondent to the interviewer through a soft phone, which was a computer-based telephone application instead of a physical telephone on the inteviewers' desks. However, if the dialer identified certain types of tones (busy signal, fax machine, no answer, etc), the dialer ended the call and dispositioned it appropriately. The dialer also had the capability to leave an automated voice message when an answering machine message was detected. Sequential dialing was implemented to allow for the calling of up to three phone numbers per case to increase the likelihood of reaching a respondent. Each phone number was dialed a minimum of three times before moving to the next phone number for the case, if any additional numbers existed. However, if a respondent requested a call back at an alternate phone number, that number was the only phone number dialed for the case. For more information on the telephony aspects of the 2010 CFU operation, please see the Telephony Design Document (2010).

The dialer managed which cases could go to which interviewers through the use of skills assignment. For example, interviewers could be assigned to take inbound calls or outbound calls but not both at the same time; language skills were also assigned.

When the dialer connected the respondent to an interviewer, the interviewer may have been located in any of the eleven call centers scattered across the United States. Table 2 lists the call centers and provides relevant details about each center.

Table 2: CFU Call Center Characteristics

Location	Start Date	End Date	Maximum Number of Interviewers	Previously TQA?
Lawrence, KS	April 11	July 24	252	Yes
Phoenix, AZ	April 11	August 14	266	Yes
Monticello, KY	April 16	July 24	685	Yes
Sandy, UT (Vangent)[6]	April 23	August 14	1250	Yes
Sandy, UT (ACS)[7]	April 23	July 24	307	Yes
Stockton, CA	April 29	August 14	343	No
Kennesaw, GA	May 2	August 14	1226	No
London, KY	May 6	July 20	1202	No
Denver, CO	May 6	August 14	309	No
Murray, UT	May 13	August 14	963	No
Ogden, UT	May 13	August 14	425	No

Source: Phase III Deliverables

The call centers did not begin calling CFU cases at once; instead, one or two call centers began calling CFU cases every week from April 11, 2010, to May 13, 2010. During the first few weeks of calls, technical and subject matter experts were available at the call centers to answer questions and resolve issues.

Five of the eleven call centers were initially used in the TQA operation. Since TQA was operationally past its peak when CFU was just beginning, these five TQA centers transitioned into CFU call centers. Former TQA interviewers were given special CFU training that addressed the similarities and differences between the two operations to ease this transition. Figure 3 shows the structure for each call center.

---

[6] Two call centers were located in Sandy, Utah, and they are distinguished by including the name of the telephony subcontractor that ran the call center. Vangent is one of the telephony subcontractors.

[7] Two call centers were located in Sandy, Utah, and they are distinguished by including the name of the telephony subcontractor that ran the call center. ACS stands for Affiliated Computer Services, one of the telephony subcontractors.

Figure 3: Call Center Structure
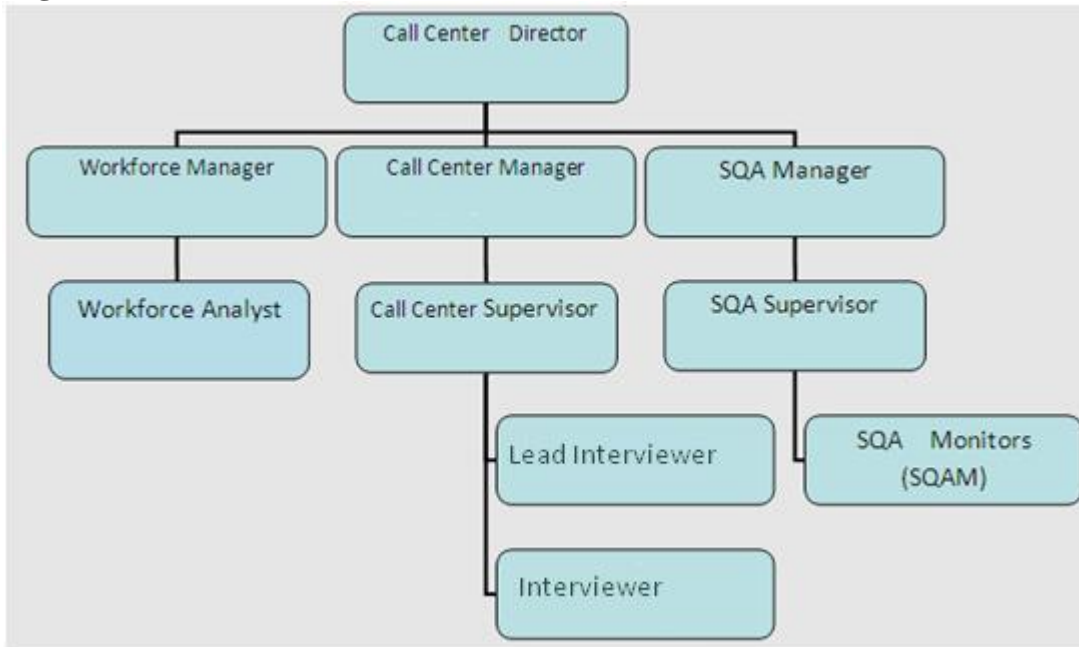
All CFU interviewers, supervisors, Service Quality Assurance (SQA) monitors, and Workforce Management employees were trained with materials designed by a contractor with input from Census Bureau subject matter experts. In addition, special training was created for bilingual interviewers and interviewers who transitioned from the TQA operation to the CFU operation in the appropriate call centers. Instead of a traditional classroom, all participants were connected via a virtual classroom powered by Adobe Connect. While a sizable amount of training occurred just before the opening of each call center, training sporadically continued throughout the operation's duration to fill empty positions. In addition, supplemental training and refresher training was occasionally released as needed to correct widespread interviewing errors observed in quality score trends and monitored calls. In all, approximately 8,000 CFU interviewers who took calls at least once during the operation were trained.

Because the workload of the CFU program was dependent on the number of census form responses received, a capacity management plan was put in place. As forms were returned to and processed by the Census Bureau, the capacity management processes monitored and projected the CFU workload against the capacity of the call centers. A baseline model was developed by DRIS based on Census Bureau experience and assumptions about staffing, productivity, length of calls, SQA rates, etc.

Changes suggested by the capacity management team affected the order of cases that were dialed. During the operation, the capacity management team chose a few days to focus on completing or closing cases where the respondent had previously refused to complete the interview. This tactic allowed the interviewers to focus on these difficult cases and also led to a Spanish queue with a higher proportion of Spanish interviews, which in turn pushed the completion rate of Spanish cases. Also, the capacity management team noticed that the likelihood of completing a case leveled off after a certain number of attempted contacts.

Consequently, cases that had already received a certain number of contacts were sometimes temporarily removed from the dialer to allow cases with fewer contacts to be completed.

2.2.4   Coverage Followup Interview

The CFU interview contained probes to identify people who were not initially included on the household roster as well as people who, according to the census residence rules, were on the roster but should not have been enumerated at the housing unit. Regardless of the source of coverage improvement, all households sent for followup received the same core questions to identify missed and erroneously enumerated people. Information gathered during the initial enumeration was passed to the CFU interview, and respondents added or deleted people from the roster of the initial return.

The CFU interview was structured in modules, which were groupings of questions that addressed different coverage problems. Not all interviews entered every module, and not all questions within a module were asked.

- Modules A and P began the interview by verifying the household and identifying an eligible respondent. New interviews began in Module A, and interviews partially completed in previous calls began in Module P.
- Module B was only entered if the respondent said that the incorrect household was reached in Module A. Questions in Module B attempted to collect information about the CFU household, and the interview could continue only if the respondent said that the CFU household had actually been reached.
- Module C verified the address of the household and collected missing tenure information. If the respondent reported that the address reached differed from the CFU address, the interview could continue only if the household had lived at the CFU address on Census Day[8] or if the CFU address was a place the household sometimes lived or stayed.
- Module D removed duplicated or unknown roster members and probed for additional roster members.
- Module E asked if any household members moved out of the household before Census Day.
- Module F probed for other places where household members sometimes lived or stayed.
- Module G collected missing demographic information.
- Module Q contained experimental questions.
- Module H ended the interview.

For more information on the 2010 CFU interview, please see the CFU Application Design Document (2010).

---

[8] Throughout this report, Census Day is April 1, 2010.

2.2.5   Service Quality Assurance Operation

The SQA operation assessed the quality of the interviewer's interaction with the respondent while on a call. The operation also provided the opportunity to identify necessary supplemental training for interviewers and to improve the interviewer's performance and the overall experience of the respondent.

Throughout the day, calls were randomly recorded by the eyeQ360 application[9], and SQA monitors scored two calls per interviewer per day. The interviewer's performance was evaluated using three criteria: Critical, Universal, and Code of Conduct. Seven of the eight Critical Criteria corresponded to the seven modules in the CFU application; these captured the interviewer's ability to collect accurate and complete data. The eighth Critical Criterion evaluated the interviewer's adherence to scripting. The Critical Criteria were so important that they were scored only *Pass* or *Fail,* and failing even one Critical Criterion meant that the call failed. A failed call resulted in immediate feedback and supervisory coaching.

The Universal Criteria evaluated an interviewer's customer service soft skills, call handling efficiency, and behaviors that helped complete interviews. There were seven Universal Criteria. Unlike Critical Criteria, the Universal Criteria were scored on a gradient scale of *Meets Standard*, *Needs Improvement*, or *Needs Significant Improvement*. Scoring a *Needs Significant Improvement* on any of the Universal Criteria—even on every one of them— did not fail the call. Coaching may have occurred, but the call was not considered to have failed.

Code of Conduct violations included behaviors such as the use of profanity, disconnecting the caller, avoiding or manipulating the call, or any other behaviors as identified by the call center's Code of Conduct policy. Similar to the Critical Criteria, Code of Conduct was either scored as a *Pass* or a *Fail*. Any Code of Conduct violation resulted in a score of zero for the overall evaluation score, and the call was considered to have failed. An interviewer that failed a call for a Code of Conduct violation was given immediate coaching or possible disciplinary action.

The SQA score of a call was calculated using the following formula:

$$SQA\ Score = \frac{Number\ of\ Earned\ Points}{Number\ of\ Possible\ Points} * 100$$

The number of earned points was the sum of points given for each item based on the SQA scoring standards.

2.2.6   Data Quality Operation

The Data Quality (DQ) operation for CFU measured the accuracy of the CFU data collected through the telephony channel. Monitors evaluated eyeQ360 recordings of interviews from a

---

[9] EyeQ360 was an audio-visual recording program that randomly recorded interviews throughout the day. Both the dialogue and the interviewer's monitor were recorded so that an SQA or Data Quality (DQ) monitor could see what was selected during the interview. An interviewer could not detect if a particular interview was being recorded by eyeQ360 while on the call.

sample of cases and focused on 15 critical questions to ensure script adherence and accurate data capture. The 15 critical questions were as follows:

- Is there anyone I've mentioned that you don't know?
- Who is the person(s) you don't know?
- Is your name correct?
- I'd like to make sure we are not missing anyone who lived or stayed here {fill address} on April 1, 2010. Other than the people we've already mentioned, were there: Any newborns or babies?
- Any other relatives who lived or stayed here?
- Anyone else who stayed here often?
- In Spring of 2010, was anyone attending college?
- Who was attending college?
- Where did {Name from who was attending college} stay while attending college?
- In April or May, did {fill "you" if person count=1, else "anyone"} stay somewhere else for an extended time or live part of the time at another residence?
- Who was staying elsewhere for an extended time during April or May?
- In April or May, where did you live or stay most of the time?
- Were you staying at {fill address} or at the other place on April 1, 2010?
- {Were you/Was Full Name} staying in any of those places on April 1, 2010?
- What was {fill Full Name's} age on April 1, 2010?

Each question was scored as *Accurate*, *Inaccurate*, *Uncertain*, or *Not Scored*. An *Accurate* score reflected that the interviewer read the critical question verbatim and the response matched the output; that is, the response provided by the respondent was accurately captured by the interviewer and shown in the data output. An *Inaccurate* score could mean that the interviewer did not read the critical question, that the respondent's response did not match what the interviewer captured, or that while the interviewer correctly captured the response, it was not reflected correctly in the data output. If the question was not read verbatim or there was an exchange between the interviewer and respondent where the respondent did not provide a clear response or the audio (from either the interviewer or respondent) was inaudible, it constituted an *Uncertain* score.

Finally, if the critical question interaction was not captured within the recording (if, for instance, it was not a part of the interview), then the question was scored as *Not Scored*.

Each call scored in DQ was given a Quality Improvement Index (QII) score. The QII was calculated using the following formula:

$$QII\ Score = \frac{Number\ of\ Accurate\ Critical\ Questions}{(Number\ of\ Accurate\ Critical\ Questions + Number\ of\ Inaccurate\ Critical\ Questions)}$$

While SQA and DQ both measured quality, they focused on different aspects. SQA looked at an interviewer's interaction with the respondent over the whole call, while DQ focused on the data

collected for specific questions. Also, the evaluations from the two operations were used in different ways. SQA scores were reported to the interviewers and meant to directly impact performance. DQ scores were aggregated and reported at high-level meetings; they never returned to the interviewer and were used to monitor trends.

3. Methodology

3.1 Research questions

3.1.1 What was the CFU workload and how was it distributed?

The question examined two different measures of the CFU workload: number of returns selected and number of returns sent. These two measures were then further examined by looking at several different characteristics of the selected and sent returns by source of coverage improvement, initial form type, wave, and language.

The data source for this analysis was the Decennial Response File (DRF).

3.1.2 Were there problems creating the CFU workload and loading it into the dialer? If so, how can they be addressed?

The question examined the lessons learned, best practices, and Census Bureau staff observations during production.

The data sources for this analysis were 2010 CFU Lessons Learned.

3.1.3 How effective was the dialer? How effective was the CFU operation at conducting an interview?

This question examined different measures as to the final disposition of the cases sent, length of the interviews, number of dials to reach a respondent, number of completed cases, and the number of contacts made to complete a case. Unfortunately, the data source that was intended to be used to answer this question was found to be too erroneous for reliable analysis. The data source, the CFU Call Detail Record (CDR), was a daily deliverable that included data of interest about every call the automatic dialer attempted. The CDR was delivered with the understanding that it may contain up to a five percent error rate; this error rate, however, when applied across every day of the four month operation, yielded a final data source that had too many errors to be useful for analysis. Errors often resulted from miscommunications between the dialer manager and the case manager. Missing records and incorrect data values made for inconsistent and unreliable longitudinal analyses, especially for many inbound calls. In addition, some of the planned analysis required that CDR data be combined with interview responses; missing or erroneous CDR records impeded this analysis. This question will therefore be answered using DRIS Phase III deliverables, which do contain some dialer analysis.

3.1.4 To what extent did the CFU operation improve coverage?

This question examined the number of cases completed, the number of cases with added people, the number of cases with deleted people, the number of people added, and the number of people deleted. These measures were then further examined by looking at several different characteristics of the completed returns by source of coverage improvement, initial form type, language, and demographic items.

The data sources for this analysis were the Decennial Response File (DRF) and the auxiliary CFU data (Aux).

3.1.5 What were the results of the CFU Service Quality Assurance operation by call center?

The average Service Quality Assurance (SQA) scores are discussed by call center, critical criteria, and universal criteria.

The data source for this analysis was the SQA Metrics data file received from DRIS. This file contained the scorecard for every call scored in SQA and captured the scores by criterion.

3.1.6 What were the results of the CFU Data Quality operation by call center?

The average Quality Improvement Index (the measure used for data quality) was examined by call center over time and by critical question.

The data source for this analysis was the DQ Metrics data file received from DRIS. This file contained the scorecard for every call scored in DQ and captured the scores by critical question.

3.1.7   How costly were these coverage improvements?

This question examined the total cost, cost per case, and cost per roster change.

The data source for this analysis is the July 2011 DRIS Contract Performance Report (CPR).

3.1.8   Were there problems administering the CFU interview and managing work? How can these problems be addressed?

The question examined the lessons learned, best practices, and Census Bureau staff observations from the call centers.

The data sources for this analysis were 2010 CFU Lessons Learned, staff observation reports, and the 2010 CFU Call Center Staff Survey.

3.2   Defining the CFU Assessment Universe

Initially the DRF was chosen as the data source for the analysis since the CFU interview data were not significantly different between the DRF and the CUF. This choice stemmed from the expectation that there was a single CFU return for each MAFID, which was then gold-plated. However, during production, and as a result of post-processing activities at headquarters, there were instances where multiple CFU returns existed for a single MAFID[10]. This usually occurred when MAFIDs that were originally assigned to different returns when the CFU universe was defined were found to represent the same housing unit during post-processing, or when multiple CFU interviews were completed and returned to the Census Bureau. To create the CUF, the primary selection algorithm (PSA) chose one CFU return to be the gold-plated return. This algorithm only applied to production cases, so in order to ensure comparability between the CFU assessment and the CFU experiment, a single algorithm was developed for all CFU cases to denote which CFU response (if multiple responses existed) should be analyzed. This was done using the following method:

The CFU responses were sorted by CENSUS_ID, DC_DATE, and then by MARK. The last record was then chosen as the primary CFU response to analyze. Essentially, the primary CFU response is the last one that was appended to the DRF. If more than one was returned within the same batch, then we selected the return that appeared to get the furthest in the interview.

Since this algorithm was conducted independently of PSA, the return selected for analysis in this assessment may differ from the return selected by PSA and thus the return on the CUF.

The data source "CFU Analysis File" that is used throughout this report is a combination of the DRF entries for initial returns sent to CFU, the CFU returns sent to the Decennial Statistical Studies Division (DSSD), and some additional information from data files related to the selection of Administrative Records and Unduplication cases.

---

[10] Please refer to Section 4.2 for further discussion on multiple CFU returns.

4. Limitations

4.1 Person Numbers Greater Than or Equal to Ten

Before a case was sent to the dialer, the household roster was evaluated for validity, stripped of any invalid persons, and renumbered. The person number variable, however, was a character variable in the database, and when a household roster with ten or more people was sorted, any roster member with an original person number of ten through 19 was put before a roster member with an original person number of one. This oversight was eventually corrected, but not before a few waves of cases had already been sent to CFU.

The largest impact of this error is to the relationship question. While most questions are asked independent of other roster members, the relationship question is asked in relation to person one. See Figure 4 for the wording on the MO/MB return.

Figure 4: Relationship Question from the MO/MB Form

2. How is this person related to Person 1? *Mark* [X] *ONE box.*

- ☐ Husband or wife
- ☐ Biological son or daughter
- ☐ Adopted son or daughter
- ☐ Stepson or stepdaughter
- ☐ Brother or sister
- ☐ Father or mother
- ☐ Grandchild

- ☐ Parent-in-law
- ☐ Son-in-law or daughter-in-law
- ☐ Other relative
- ☐ Roomer or boarder
- ☐ Housemate or roommate
- ☐ Unmarried partner
- ☐ Other nonrelative

Since the CFU interview asked only the demographic items that were missing and saved all other demographic information, some cases had mixed reference persons for the relationship question. While the CFU returns sent to HQP were resorted and resent in order to have the person number correspond to the correct person record, the relationship data could not have been changed without an additional CFU interview. This report does not attempt to correct any relationship values, but it does use the CFU return that was reordered.

4.2 Multiple Returns

Two DRIS servers housed all CFU data during the operation. While these servers frequently communicated to each other throughout the operational period, they did not communicate in real time. As a result, a single case was occasionally contacted multiple times in one day by different call centers that pulled from the two servers. Consequently, some cases were interviewed multiple times because the completed interview data housed in one server had not yet been shared with the other server. In addition, due to a telephony miscommunication, some CFU returns were occasionally sent to HQP multiple times; that is, multiple CFU returns existed for some cases where the information was exactly the same across the CFU returns for each case. To prepare the data for this assessment, the last and most complete CFU return was selected from multiple returns for each case[11]. Therefore, for cases where multiple returns were received

---

[11] This process is described in more detail in Section 3.2.

by DSSD, not all completed interviews are represented in this assessment. The order of receipt from DSSD may have differed from HQP's order of receipt, so this assessment may choose a completed interview for analysis that differs from the completed interview selected for processing by HQP but is still considered an acceptable completed interview.

Also, the updating of MAFIDs for originally unique returns that were determined to be the same housing unit during post-processing sometimes caused CFU returns that were initially from unique cases to be identified with the same MAFID. Thus, while a case may have been completed only once in CFU, the updated MAFID may link to multiple CFU returns. This report considers cases as unique by CFU standards – i.e., before any MAFID changes were made; therefore, data within this report may not compare to data pulled from other sources.

During case selection, cases were screened to ensure that each case was sent to the CFU operation only once. Sixteen cases, however, were sent to CFU twice, and in some cases, multiple CFU interviews were completed for these cases. Two different returns were selected and sent to CFU for each of these sixteen cases, and one of the two returns for each of the sixteen cases was sent in wave 8B with a non-production source of coverage improvement. Either these cases were not initially flagged as having been already sent, or the selection algorithm did not properly note the flag, but these sixteen cases were sent to CFU again in error. Similar to instances where multiple CFU returns existed for one case, the last, most complete interview was selected for the workload and operational results sections of this report. Because the dialer section draws numbers from results created by DRIS staff, the dialer and cost sections will include both returns of these sixteen cases.

4.3   The Call Detail Record

The CFU CDR was a file delivered from DRIS that recorded various elements about every call attempted or received every day during the length of production. This file was delivered every day, and the aggregation of the daily deliveries was intended to be used in this report's dialer analysis section. The daily CDRs were accepted with a maximum error rate of five percent; unfortunately, the files did contain errors, and the magnitude of the errors once the files were aggregated was too great to allow the usage of the CDR in this report. An example of the kind of error seen in the CDR was missing or incomplete entries in each daily report that made tracking the contact histories of specific cases a patchy endeavor. Errors were usually the result of miscommunication between the dialer and the application that managed the cases in CFU.

As a result of the compounding errors in the CDR, the original dialer question was answered as completely as possible by using reports generated by DRIS staff. These reports, however, rely on the same data source and likely have similar issues as any original analysis from the CDR may have had. Readers are seriously cautioned when using any dialer results presented in this assessment. Despite these errors, we do have some level of confidence in the data, and we find that the general trends present in the dialer numbers provide a useful view into how the dialer worked during the 2010 CFU operation.

4.4   Residence Coding

After the CFU interview returns were sent to HQP for processing, all roster members underwent residence coding. This process used information collected during the CFU interview to determine if any existing roster members or people who were attempted to be added to household rosters were actually residents of the housing unit. During attempts to duplicate the residence coding for verification purposes, we noticed that the production residence coding was slightly different than expected. The impact was that roster members who should have been identified as non-residents solely for living in a jail or prison were instead identified as residents. All tables, except for Table 30, use the residence coding logic actually used in production and thus may not account for the roster members who should have not been residents.

4.5   Other Limitations

Because the Data Quality operation's file relied on the CDR for some fields, it contained a small amount of error. Most notably, 84 cases did not have a call center identifier. These cases were included in overall totals in this report, but were omitted when the DQ universe was divided by call center.

One case in the SQA file had a score of zero for all scorecard items. This case was not included in any analysis contained in this report.

An unknown processing error occurred during case selection where some non-production cases were excluded from the remove overlap process. During one wave of selection, some non-production cases were not recognized by the process that ensured that only one return was sent to CFU for each MAFID. As a result, these cases not recognized by the remove overlap process were never sent to CFU. This affects some counts in the results section of this report.

Some data points were irretrievable from the DRF or the CFU interview data due to looping. The last response for each question was recorded in the CFU interview data files, so any previous responses that differed from the final response for that data point cannot be analyzed. In this report, this limitation affects the analysis of people added to household rosters.

Some tables were restricted to completed production cases. This demarcation led to the exclusion of a small subset of cases with a production reason. Due to the simultaneous processing of different programs, some cases were selected for both production and non-production reasons but were identified as a non-production case. A total of 918 cases were sampled for CFU for an evaluation reason but were also identified as an eligible case using administrative records. Of those 918 cases, 574 completed an interview. These 574 cases were not returned to HQP for residence coding, so the outcomes of these cases did not affect the census counts. Hence, while these 574 cases would have been considered production cases had the evaluation selection and the AR selection not occurred within the same wave, they are considered evaluation cases for the purposes of this assessment and are not included in counts of completed cases.

Due to different data definitions, the results presented in this report may not match numbers contained in Cost and Progress reports. For example, the Cost and Progress Executive Report shows 4,859,467 completed cases and this report shows 4,865,612 completed cases in Table 26. Cost and Progress reports pulled data from the CDR data extract and the WCM; however,

progress data in this report came from CFU auxiliary data delivered to DSSD during production, DRIS Phase III deliverables, and the DRF.

5. Results

5.1   CFU Workload Analysis: Case Selection Process

DSPO conducted CFU case selection processing over 11 waves. DSPO began the case selection process by identifying eligible responses for each of the 11 CFU waves. The CFU eligible universe had three main requirements[12]:

 1) The CFU eligible response came from one of the following collection methods:

   - MO/MB
   - U/L questionnaires
   - Nonresponse Followup (NRFU) enumerator questionnaires
   - Update/Enumerate (U/E) questionnaires
   - TQA

 2) The CFU eligible response had a MAFID that had never been assigned a processing identifier during the 2010 Census.[13]

 3) The CFU eligible response came from a housing unit, where one person qualified as a Data Capture Audit and Resolution (DCAR) valid person[14].

DSPO and CARRA used the CFU eligible universe to select returns for each wave. The CFU eligible universe included the following types of cases: LHH, CD, CP, and AR. LHH, CD, overcount, and undercount returns were selected by DSPO in all 11 waves; AR returns were selected by CARRA in Wave 8 but sent in Wave 9.

Except where noted, the workload analysis presented in this report is limited to cases with at least one production source of coverage improvement. For cases with only evaluation sources of coverage improvement, please see the Evaluation of Administrative Records Use for Coverage Problems and the Evaluation of the Effectiveness of Unduplication.

---

[12] For additional information related to the CFU eligible universe, please see the memorandum, "Identification of the 2010 Coverage Followup Eligible Universe and Selection Requirements", Kostanich, 2009a.

[13] Cases sent to DRIS for CFU are identified by MAFID on the UECT. DRIS does not get MAFID updates for responses with processing IDs, therefore DRIS is unable to lookup the response based on MAFID.

[14] For additional information related to the remove overlap process, please see the memorandum, "2010 Coverage Followup Remove Overlap Requirements", Kostanich, 2009b.

5.1.1   Returns Selected For CFU

Table 3 shows the number of CFU returns selected by source of coverage improvement. All production sources are listed, as well as the category of "Other Sources"[15]. Since the outcomes of the returns that have "Other Sources" of coverage improvement are for evaluative purposes, detailed discussion of these returns are not within the scope of this assessment. The total number of returns selected for CFU production was 7,781,648. The Unduplicated Total row combines the number of returns selected for production categories and the "Other Sources" category; it counts all returns once, regardless of how many sources of coverage improvement it had. This Unduplicated Total number is used as the denominator for calculating the percentages in Table 3; hence, the percentages will not total to 100 percent. The Unduplicated Total was used in percentages to give the reader a gauge of how prevalent each source of coverage improvement was in the actual workload.

Table 3: Selected Workload Distribution by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns Selected	Percent
Large Households	1,442,575	17.5
Count Discrepancies	2,020,775	**24.6
High	1,312,165	15.9
Low	708,610	8.6
Undercount	2,365,615	28.7
Children	405,362	4.9
Relatives	963,517	11.7
Nonrelatives	286,343	3.5
People staying temporarily	710,393	8.6
Overcount	2,484,510	**30.2
In college housing	1,015,233	12.3
In the military	532,786	6.5
In jail or prison	92,983	1.1
In a nursing home	108,544	1.3
Person Multiple	187,941	2.3
Household Multiple	547,023	6.6
Administrative Records	641,425	7.8
Other Sources	448,808	5.5
Unduplicated Total	**8,230,456**	

Source: CFU Analysis File
* Sources of coverage improvement are not mutually exclusive.
** Percentages are not equal to the sum of the subcategories due to rounding.

---

[15] For further details and analysis regarding the "Other Sources" category, please see the Evaluation of Administrative Records Use for Coverage Problems by Timothy Stewart.

Overcount returns accounted for the largest source of coverage improvement (30.2 percent) of the CFU workload selected. A return could be part of the overcount category for one of the following reasons:

- At least one person responded 'yes' to the overcount coverage probe and marked only one of the categories: 'in college housing', 'in the military', 'in a jail or prison', or 'in a nursing home'.
- One person marked multiple overcount categories.
- Multiple people marked different overcount categories (Blough, 2010).

Table 4 shows the number of returns selected by DSPO and CARRA in each of the 11 waves. Of the total CFU selected universe, 78 percent of returns were selected during waves 1 through 6. The workload distribution was dependent upon the data capture of paper forms. LHH, high count discrepancy, overcount, and undercount returns followed the trend of distributing the majority of their workloads through waves 1 through 6. However, low count discrepancy returns were more evenly distributed across all waves when compared to the total workload. Administrative Records returns were selected in Wave 8 only. For the distribution of cases selected by wave for each source of coverage improvement, see Appendix A: Additional Workload Tables.

Table 4: Selected Workload Distribution by Wave

Wave	Number of Returns Selected	Percent
1	1,117,136	13.6
2	1,073,893	13.0
3	914,142	11.1
4	1,010,101	12.3
5	1,251,661	15.2
6	1,049,869	12.8
7	506,490	6.2
8	386,790	4.7
9	486,716	5.9
10	281,319	3.4
11	152,339	1.9
Total	**8,230,456**	**100.0***

Source: CFU Analysis File
*Percentages may not total 100 due to rounding

Low count discrepancy returns did not have the same trend of workload distribution as the total workload; returns were selected more evenly throughout all waves than the total CFU workload. Low count discrepancy had its highest percentage of returns selected in Waves 9 and 10, 13.5 percent and 10.7 percent, respectively. Table 5 shows the distribution of selected low count discrepancy cases by wave for comparison against Table 4.

Table 5: Number of Low Count Discrepancy Returns Selected by Wave

Wave	Number of Returns Selected	Percent
1	74,732	10.5
2	69,151	9.8
3	60,424	8.5
4	60,610	8.6
5	75,021	10.6
6	68,881	9.7
7	37,658	5.3
8	50,257	7.1
9	95,727	13.5
10	75,877	10.7
11	40,272	5.7
Total	**708,610**	**100.0**

Source: CFU Analysis File

The AR universe was created differently than the other sources of coverage improvement. DSSD delivered a file of CFU eligible responses through Wave 8 to CARRA. Using this file, CARRA created a universe of returns based on modeling from administrative records. The CFU AR universe included responses where an expected number of missing persons on a census return was greater than or equal to 0.20. CARRA sent the AR file to DSPO for Wave 8 return selection (Kostanich, 2009c). All selected AR returns were selected in Wave 8.

Table 6 shows the CFU workload was made up of 85.9 percent respondent-provided form types and 14.1 percent enumerator-provided form types. The differences between the two form type categories may be caused by several factors. Enumerator-provided form types were completed with the assistance of a U.S. Census Bureau employee and were potentially less likely to include residency and count discrepancy errors. Also, the enumerator-provided form types had a limited universe: enumerator returns with supplemental forms were not linked during the creation of the CFU eligible universe and were therefore not eligible for CFU. In addition, the CFU universe began creation on March 29, 2010 and Waves 1 through 4 were created by April 26, 2010[16]. MO/MB forms were included from the beginning of CFU universe creation in Wave 1. Conversely, the NRFU operation, which accounted for 97.6 percent of all enumerator-provided returns, began May 1, 2010 and completed all residual work by August 24, 2010. After allowing time for interviewing, data capture, and processing, NRFU returns did not have as much time as respondent-provided form types to be included as part of the CFU eligible universe.

---

[16] Additional information related to the CFU and NRFU schedules can be found in Appendix B.

Table 6: Selected Workload by Form Type

Form Type	Number of Returns Selected	Percent of Total Selected Cases	Total Number of Returns[17]
Respondent-Provided	7,067,660	85.9*	92,508,507
MO/MB -- English	6,073,629	73.8	83,660,322
MO/MB -- Bilingual	871,256	10.6	7,383,228
MO/MB -- Fulfillment	12,887	0.2	83,199
U/L -- English Stateside	512	0.0	6,647
U/L -- Puerto Rico	106,784	1.3	1,375,111
Enumerator-Provided	1,162,796	14.1	27,965,116
TQA	1,037	0.0	22,102
NRFU	1,134,641	13.8	27,272,458
U/E	27,118	0.3	670,556
Total	**8,230,456**	**100.0**	**120,473,623**

Source: CFU Analysis File

* Percentages may not be equal to the sum of their subcategories due to rounding.

Table 7 delineates the English MO/MB forms by the number of initial and replacement forms selected by each source of coverage improvement. There were a total of 6,073,629 English MO/MB forms selected; 90.3 percent were initial forms and 9.7 percent were replacement forms.

The initial and replacement form types had different distributions across sources of coverage improvement. Most notably, overcount returns made up the largest percentage of initial English MO/MB forms (32.1 percent), but undercount returns made up the largest percentage of replacement English MO/MB forms (31.8 percent).

---

[17] This column is included to give the reader a general idea of the number of returns received for each form type and should not be considered official. The content is comprised of numbers from a variety of sources that may not completely match CFU's requirements for selection. For example, the number of NRFU returns excludes cases that have continuation forms but does not exclude cases with an invalid population count.

Table 7: Type of English Mailout/Mailback Return by Source of Coverage Improvement

Source of Coverage Improvement*	Type of English Mailout/Mailback Form	
	Number of Initial Forms Selected	Number of Replacement Forms Selected
Large Households	1,100,709	147,828
Count Discrepancies	1,195,466	152,621
High	866,333	100,375
Low	329,133	52,246
Undercount	1,603,111	188,257
Children	288,174	37,074
Relatives	653,256	66,736
Nonrelatives	147,477	21,348
People staying temporarily	514,204	63,099
Overcount	1,760,508	138,358
In college housing	784,830	39,716
In the military	315,326	30,795
In jail or prison	50,675	8,200
In a nursing home	70,845	5,260
Person Multiple	129,368	13,046
Household Multiple	409,464	41,341
Administrative Records	438,543	43,590
Unduplicated Total	**5,482,534**	**591,095**

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

Table 8 illustrates the distribution of the CFU workload by the language reported on the initial CFU selected form. CFU supported six language campaigns: English, Spanish, Chinese, Korean, Russian, and Vietnamese. However, there were 45 additional language categories reported on Enumerator Questionnaires eligible for CFU. These additional language categories were included within the English category since the additional languages were not supported in CFU. The English category made up 94 percent of CFU selected returns.

The Chinese category is also comprised of multiple languages, which include: Chinese, Chinese Simplified, and Chinese Traditional. Chinese, Korean, Russian, and Vietnamese combined to represent less than one percent of the CFU returns selected.

Table 8: Selected Returns by Form Language

Form Language	Number of Returns Selected	Percent
English	7,733,668	94.0
Spanish	494,502	6.0
Chinese	1,278	0.0
Korean	400	0.0
Russian	285	0.0
Vietnamese	323	0.0
Total	**8,230,456**	**100.0**

Source: CFU Analysis File

Table 9 shows the majority of selected English language returns were undercount and overcount returns. The selected English language workload consisted of 28.4 percent undercount returns and 31.4 percent overcount returns, respectively.

Table 9: Number of Selected English Returns by Source of Coverage Improvement

Source of Coverage Improvement*	Number of English Returns Selected	Percent
Large Households	1,332,775	17.2
Count Discrepancies	1,836,794	23.8
High	1,180,219	15.3
Low	656,575	8.5
Undercount	2,195,318	28.4
Children	368,512	4.8
Relatives	889,787	11.5
Nonrelatives	266,179	3.4
People staying temporarily	670,840	8.7
Overcount	2,425,996	31.4**
In college housing	996,726	12.9
In the military	524,972	6.8
In jail or prison	90,060	1.2
In a nursing home	105,551	1.4
Person Multiple	181,977	2.4
Household Multiple	526,710	6.8
Administrative Records	588,105	7.6
Unduplicated Total	**7,733,668**	

Source: CFU Analysis File
*Sources of coverage improvement are not mutually exclusive.
** Percentage is not equal to the sum of the subcategories due to rounding.

The distributions of the Spanish and English workloads were similar for most sources of coverage improvement, except overcount and count discrepancy returns. Table 10 shows overcount returns made up 11.7 percent of the selected Spanish workload.

Table 10: Selected Spanish Returns by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Spanish Returns Selected	Percent
Large Households	109,618	22.2
Count Discrepancies	183,202	37.0
High	131,611	26.6
Low	51,591	10.4
Undercount	169,567	34.3**
Children	36,778	7.4
Relatives	73,333	14.8
Nonrelatives	19,963	4.0
People staying temporarily	39,493	8.0
Overcount	58,039	11.7**
In college housing	18,223	3.7
In the military	7,773	1.6
In jail or prison	2,910	0.6
In a nursing home	2,934	0.6
Person Multiple	5,924	1.2
Household Multiple	20,275	4.1
Administrative Records	53,094	10.7
Unduplicated Total	**494,502**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentages are not equal to the sum of the subcategories due to rounding.

Table 11 shows the combined total of Russian, Vietnamese, Korean, and Chinese returns by source of coverage improvement. These languages combined for 2,286 CFU selected returns. Count discrepancies returns contributed the largest percentage of the workload with 34.1 percent. For a detailed distribution of Russian, Vietnamese, Korean, or Chinese cases selected by source of coverage improvement, see Appendix A: Additional Workload Tables.

Table 11: Selected Other Language Returns by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Selected	Percent
Large Households	182	8.0
Count Discrepancies	778	34.1
High	335	14.7
Low	443	19.4
Undercount	730	31.9
Children	72	3.1
Relatives	397	17.4
Nonrelatives	201	8.8
People staying temporarily	60	2.6
Overcount	473	20.7
In college housing	284	12.4
In the military	41	1.8
In jail or prison	13	0.6
In a nursing home	59	2.6
Person Multiple	40	1.7
Household Multiple	36	1.6
Administrative Records	233	10.2
Unduplicated Total	**2,286**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

5.1.2 Returns Sent to CFU

A total of 8,053,052[18]returns out of 8,230,456 selected were sent to DRIS. DSPO used five unique criteria to determine the universe of returns to send. The criteria ensured the returns had sufficient, valid data and limited the possibility of conducting multiple interviews for one household. Table 12 shows the distribution of returns that were selected, but not sent, by each of the five possible reasons.

---

[18] This figure represents the number of unique returns sent to DRIS. The total CFU workload sent to DRIS was 8,053,068; however, this total included 16 cases that had duplicate MAFIDS. These 16 cases were attempted, but DRIS only sent one record of these cases to DSPO for response processing.

Table 12: Selected Returns Not Sent by Reason

Reason	Number of Returns Not Sent	Percent*
Housing unit sent in earlier wave	118,621	67.3
Incorrect number of valid persons	82	0.0
No address	32,938	18.7
Not selected as primary response	15,719	8.9
Did not pass valid person check for first six people	8,838	5.0
Total[19]	**176,198**	**100.0**

Source: CFU Analysis File
* Percentages may not total 100 due to rounding

Of the selected returns not sent for a CFU interview, 67.3 percent were not sent because the housing unit had been sent in an earlier wave. In order to avoid duplication and increased respondent burden, only one return was sent for a household. "Not selected as primary response" was the reason code for 8.9 percent of returns. A housing unit may have had multiple eligible returns within a single CFU wave, but the remove overlap process selected only one primary response for each housing unit. Therefore, the returns not selected as the primary response were not sent for a followup interview.

The three reason codes that verified data completeness were "Incorrect number of valid persons," "No address," and "Did not pass valid person check for first six people." All CFU returns needed a valid address for the interview. Also, the first six DCAR-valid people on the roster needed to have at least one person with a blank age or an age greater than 14 and at least one person with at least two characters in the captured last name. These three reason codes combined for 23.7 percent of the returns not sent.

The workload distribution shown in Table 13 is nearly identical to the workload distribution for the number of returns selected. There are minor differences between the number of returns selected and sent within the count discrepancy and AR sources. Count discrepancy returns composed 24.6 percent of the CFU workload selected and 24.4 percent of the CFU workload sent. AR returns contributed to 7.8 percent of the CFU workload selected and 7.9 percent of the CFU workload sent.

Each source of coverage improvement had slightly different rates of returns sent compared to returns selected. A total of 633,730 out of 641,425 AR returns selected were sent for a followup interview; this is approximately 98.8 percent, the highest of any source. A total of 1,965,538 out of 2,020,775 count discrepancy returns selected were sent for a followup interview; this is approximately 97.3 percent, the lowest of any source.

---

[19] There is a 1,206 return discrepancy between the number of returns assigned a 'Not Sent' reason code and the difference between the number of returns sent and selected. This discrepancy is attributed to some cases being selected but never included in remove overlap processing due to a processing error.

Table 13: Sent Workload by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns Sent	Percent	
Large Households	1,409,128	17.5	
Count Discrepancies	1,965,538	24.4	
High	1,279,659		15.9
Low	685,879		8.5
Undercount	2,312,460	28.7	
Children	396,330		4.9
Relatives	939,542		11.7
Nonrelatives	280,687		3.5
People staying temporarily	695,901		8.6
Overcount	2,432,646	30.2	
In college housing	996,804		12.4
In the military	519,283		6.4
In jail or prison	90,271		1.1
In a nursing home	105,942		1.3
Person Multiple	184,381		2.3
Household Multiple	535,965		6.7
Administrative Records	633,730	7.9	
Other Sources[20]	446,018	5.5	
Unduplicated Total	**8,053,052**		

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

Similar to the distribution of returns selected in Table 4, Table 14 shows the distribution of returns sent to DRIS by wave. The differences from projected numbers are related to the fact that fewer cases were selected than expected and that NRFU return processing was later than planned. A significant percentage (68.8 percent) of the total CFU workload was sent in Waves 1 through 6. However, 1,225,364 returns were sent during Wave 9; this is the largest number of returns sent for one particular wave. Wave 9 included 525,584 AR returns as well as cases with other non-production sources of coverage improvement. Cases with non-production sources of coverage improvement were selected in each wave in a similar fashion as non-AR production cases, but were not sent until Waves 8 and 9. In addition, 253,466 evaluation cases were sent in Wave 9.

---

[20] This category is composed of the Evaluation, Unduplication, and Research returns also included in CFU but not within the scope of this assessment.

Table 14: Projected and Actual Workload by Wave

Wave	Projected Number of Returns	Percent	Number of Returns Sent	Percent
1	1,042,747	11.5	974,024	12.1
2	854,443	9.4	936,728	11.6
3	776,765	8.6	786,900	9.8
4	776,765	8.6	865,585	10.7
5	776,765	8.6	1,077,207	13.4
6	776,765	8.6	900,621	11.2
7	776,765	8.6	429,347	5.3
8	1,873,543	20.7	484,385	6.0
9	712,697	7.9	1,225,364	15.2
10	521,562	5.8	286,028	3.6
11	160,476	1.8	86,863	1.1
Total	**9,049,295**	**100.0**	**8,053,052**	**100.0**

Source: CFU Analysis File

Low count discrepancy returns did not have the same trend of workload distribution as the total workload; returns were sent more evenly throughout all waves than the total workload. The low count discrepancy category had its highest percentage of returns sent, 13.5 percent, in Wave 9.

Table 15: Sent Low Count Discrepancy Returns by Wave

Wave	Number of CD-Low Returns Sent	Percent
1	73,252	10.7
2	68,156	9.9
3	59,043	8.6
4	59,559	8.7
5	73,778	10.8
6	67,153	9.8
7	36,789	5.4
8	48,991	7.1
9	92,743	13.5
10	73,482	10.7
11	32,933	4.8
Total	**685,879**	**100.0**

Source: CFU Analysis File

Although the AR universe was selected in Wave 8, it was sent for followup during Waves 8 and 9. The majority of AR returns, 82.9 percent, were sent in Wave 9.

Wave	Number of AR Returns Sent	Percent
8	108,146	17.1
9	525,584	82.9
Total	**633,730**	**100.00**

Source: CFU Analysis File

For the distribution of cases sent to DRIS by wave for each source of coverage improvement, see Appendix A: Additional Workload Tables.

Table 17 shows 86.1 percent of the CFU workload sent contained respondent-provided form types and 13.9 percent contained enumerator-provided form types. Enumerator-provided form types yielded a greater percentage of returns sent out of their workload than respondent-provided form types. Out of 1,162,796 (98.1 percent) selected enumerator-provided returns, 1,118,102 were sent for followup; however, 6,934,950 out of 7,067,660 (96.2 percent) of respondent-provided returns selected were sent for followup.

Table 17: Sent Workload by Form Type

Form Type	Number of Returns Sent	Percent
Respondent Provided	6,934,950	86.1
MO/MB – English	5,986,045	74.3
MO/MB – Bilingual	866,658	10.8
MO/MB – Fulfillment	15,143	0.2
U/L -- English Stateside	503	0.0
U/L -- Puerto Rico	66,601	0.8
Enumerator Provided	1,118,102	13.9
TQA	1,021	0.0
NRFU	1,091,554	13.6
U/E	25,527	0.3
Total	**8,053,052**	**100.0**

Source: CFU Analysis File

Table 18 delineates the English MO/MB form by the number of initial and replacement forms sent by each source of coverage improvement. There were a total of 5,986,045 English MO/MB forms sent; 91 percent were initial forms and 9 percent were replacement forms. A large number of replacement English MO/MB returns were not sent compared to the number of initial English MO/MB returns sent. A total of 5,444,602 out of 5,482,534 initial English MO/MB returns selected were sent for followup; this is approximately 99.3 percent. Conversely, a total of 541,443 out of 591,095 replacement English MO/MB returns selected were sent for followup; this is approximately 91.6 percent. This disparity could be due to the requirement that a household have only one return sent to CFU. Households that returned both an initial and a replacement MO/MB questionnaire and that had both qualify for CFU would only have one sent to CFU. The selection algorithm could have removed some replacement MO/MB questionnaires from the CFU universe for this reason.

---

[21] Due to timing of available files, most AR returns were sent in Wave 9

The initial and replacement form types had different distributions across sources of coverage improvement. Most notably, overcount returns made up the largest percentage of initial English MO/MB forms (32.2 percent), but undercount returns made up the largest percentage of replacement English MO/MB forms (32.1 percent).

Table 18: Sent English Mailout/Mailback Returns by Source of Coverage Improvement

Source of Coverage Improvement*	Type of English Mailout/Mailback Form	
	Number of Initial Forms Sent	Number of Replacement Forms Sent
Large Households	1,088,650	134,665
Count Discrepancies	1,183,013	139,657
High	858,620	91,721
Low	324,393	47,936
Undercount	1,489,767	173,937
Children	255,838	34,245
Relatives	576,565	60,911
Nonrelatives	146,580	20,034
People staying temporarily	510,784	58,747
Overcount	1,750,695	124,991
In college housing	781,575	35,215
In the military	313,904	28,057
In jail or prison	50,144	7,178
In a nursing home	70,203	4,554
Person Multiple	128,373	12,029
Household Multiple	406,496	37,958
Administrative Records	438,066	37,446
Unduplicated Total	**5,444,602**	**541,443**

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

Table 19 illustrates the distribution of the CFU workload by the language reported on forms sent to CFU. The English category made up 94.4 percent of returns sent to CFU. There were more Chinese returns sent, 1,243, than Korean, Russian and Vietnamese returns sent combined, 979.

Table 19: Number of Returns Sent by Form Language

Form Language	Number of Returns Sent	Percent
English	7,601,251	94.4
Spanish	449,579	5.6
Chinese	1,243	0.0
Korean	394	0.0
Russian	278	0.0
Vietnamese	307	0.0
Total	8,053,052	100.0

Source: CFU Analysis File

Table 20 shows overcount returns comprised 31.3 percent of English language returns sent, the largest of any one source of coverage improvement. Undercount returns had the next highest percentage of the English language workload sent with 28.4 percent.

Table 20: Number of English Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of English Returns Sent	Percent
Large Households	1,306,867	17.2
Count Discrepancies	1,800,136	23.7
High	1,159,798	15.3
Low	640,338	8.4
Undercount	2,158,945	28.4
Children	361,920	4.8
Relatives	873,850	11.5
Nonrelatives	261,559	3.4
People staying temporarily	661,616	8.7
Overcount	2,381,574	31.3**
In college housing	979,994	12.9
In the military	513,139	6.8
In jail or prison	87,652	1.2
In a nursing home	103,498	1.4
Person Multiple	179,151	2.4
Household Multiple	518,140	6.8
Administrative Records	580,739	7.6
Unduplicated Total	**7,601,251**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentage is not equal to the sum of the subcategories due to rounding.

Table 21 shows count discrepancy returns contributed to the largest percentage, 36.6 percent, of the Spanish workload sent. Conversely, overcount returns had the least percentage, 11.3 percent, of the Spanish workload sent.

Table 21: Number of Spanish Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Spanish Returns Sent	Percent
Large Households	102,084	22.7
Count Discrepancies	164,642	36.6
High	119,532	26.6
Low	45,110	10.0
Undercount	152,796	34.0**
Children	34,338	7.6
Relatives	65,302	14.5
Nonrelatives	18,929	4.2
People staying temporarily	34,227	7.6
Overcount	50,621	11.3**
In college housing	16,539	3.7
In the military	6,105	1.4
In jail or prison	2,606	0.6
In a nursing home	2,388	0.5
Person Multiple	5,191	1.2
Household Multiple	17,792	4.0
Administrative Records	52,775	11.7
Unduplicated Total	**449,579**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentage is not equal to the sum of the subcategories due to rounding.

Table 22 shows the combined total of Chinese, Korean, Russian, and Vietnamese returns sent by source of coverage improvement. The distribution of returns by source of coverage improvement is similar to the English and Spanish workloads sent, except for LHH returns. LHH returns made up 8 percent of the Other Language workload sent, the lowest percentage for any one source of coverage improvement. For a detailed distribution of Russian, Vietnamese, Korean, or Chinese cases sent to DRIS by source of coverage improvement, see Appendix A: Additional Workload Tables.

Table 22: Number of Other Language Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Sent	Percent
Large Households	177	8.0
Count Discrepancies	776	34.9
High	334	15.0
Low	442	19.9
Undercount	729	32.8
Children	72	3.2
Relatives	397	17.9
Nonrelatives	200	9.0
People staying temporarily	60	2.7
Overcount	474	21.3**
In college housing	284	12.8
In the military	41	1.8
In jail or prison	13	0.6
In a nursing home	59	2.7
Person Multiple	40	1.8
Household Multiple	37	1.7
Administrative Records	227	10.2
Unduplicated Total	**2,222**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentage is not equal to the sum of the subcategories due to rounding.

5.2 Case Selection Lessons Learned

Overall, case selection performed as expected. Each wave was sent to DRIS either on time or even early. Communication regarding the number, types, and distribution of cases selected as well as the cases sent to DRIS was excellent. A few areas could be improved, however.

5.2.1 DCAR CFU Valid Flag

While returns were selected for CFU at a household-level, the persons within the household were examined to verify that there was sufficient data to identify them within the CFU interview. Within DCAR, a variable called DCAR_CFU_STATUS was set. Basically, it required the person to be DCAR valid (meaning at least two of the following items had to be filled: name, relationship, sex, age or date of birth, Hispanic origin, and race) as well as either the first and last name fields had to have a combined total of three legal characters or age was present and was between 0 and 125.

The purpose of the person record having a sufficient name or age was to be able to identify that specific person during the CFU interview, specifically to verify the household roster.

Figure 5: Review Roster Screen Shot*
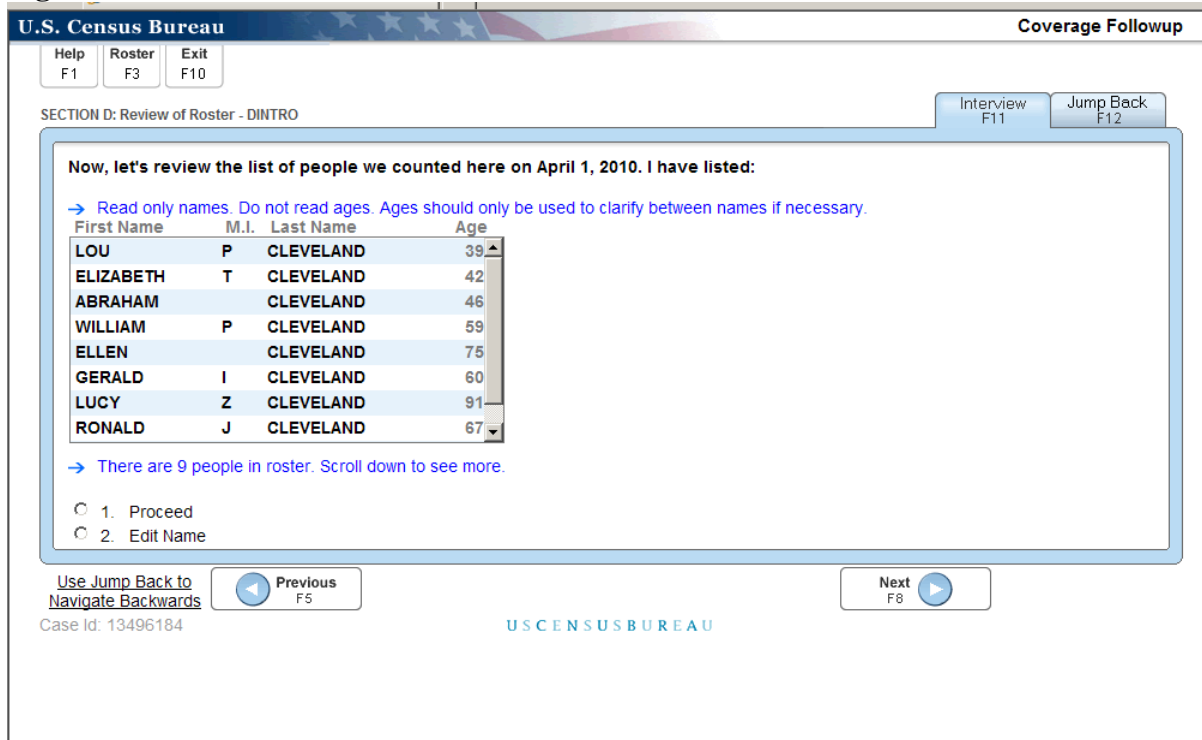
*All data in this screen shot are fictitious.

During interviewing, there were numerous occasions where observers noted that not only was a name blank on the roster, but the age was blank as well. Thus, on the screen shown in Figure 5, the interviewers would not have noticed an additional household member. It was not until later in the interview that the interviewer noticed a problem when screens that were supposed to have the name filled appeared to only have blank spaces. For example, in the screen shot in Figure 6, rather than seeing "Abigail J Fillmore" in the question text, the interviewer would have seen a blank space.

Figure 6: Relationship Question Screen Shot*
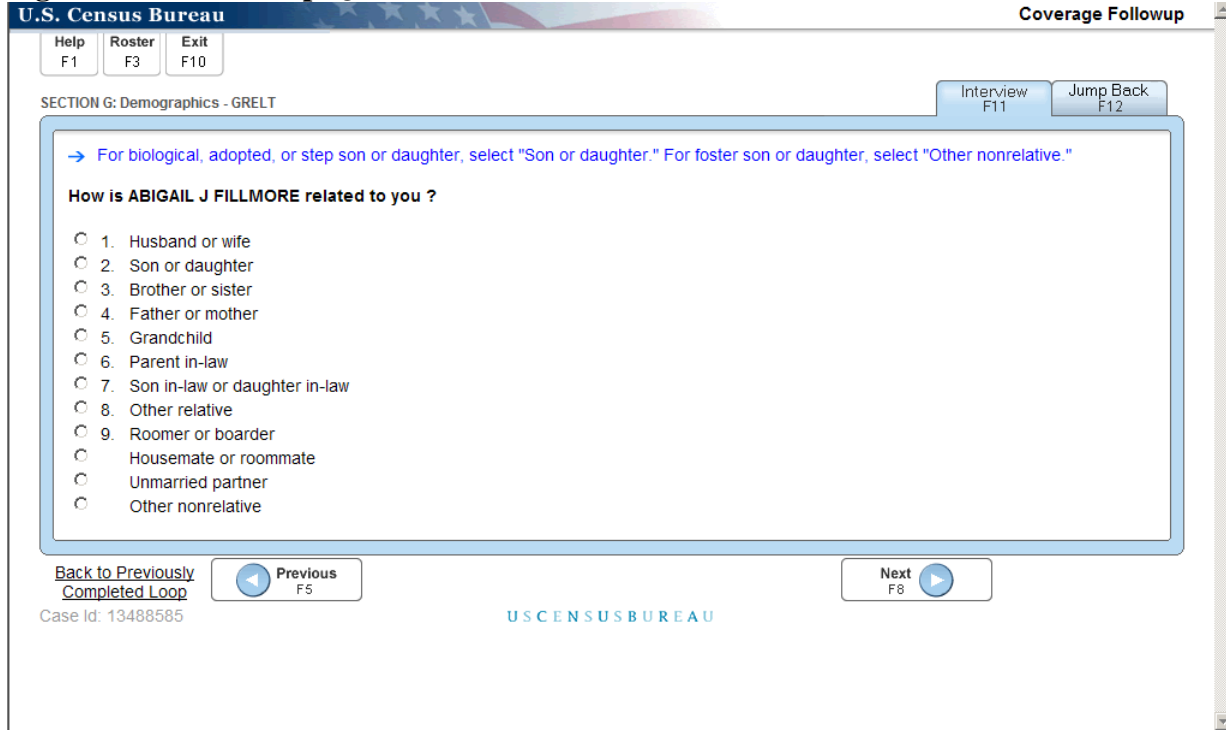
*All data in this screen shot are fictitious.

This caused the interviewers to believe that there was a technical error. However, upon further examination, this was not the case. Instead, WCM did not program the DCAR_CFU_STATUS flag according to DRIS expectations. Rather than evaluating if age was present (in terms of the AGE_YEARS variable), WCM considered age present if it could be calculated from the date of birth. This is what caused person records to be sent to CFU that had neither a name nor an age (and thus appeared as being blank in the CFU interview).

We were only able to identify the problem post production after requesting documentation (or confirmation) as to how the DCAR_CFU_STATUS variable was programmed. The problem could have potentially been resolved prior to production had the Census Bureau been more involved in observing testing or had been given more visibility into the design documentation or specifications of this piece of the program.

5.2.2   Testing DSPO Programs

Testing DSPO programs was a positive and successful process, but a few errors slipped through. One observed error involved the selection of enumerator records for CFU. Instead of allowing zero to be a valid value of POP_COUNT given a valid number of person records were detected on the return, enumerator records were selected such that cases with a POP_COUNT of zero were not considered valid for the CFU workload. This particularly affected selection of count discrepancy cases. No change requests were submitted because this error was discovered after production ended.

In addition, additional testing may have prevented the sixteen cases from being sent to CFU twice and the 1,206 cases from being left out of remove overlap processing. Overall, though, the selection of the 8,230,456 cases was successful.

5.2.3 Group Quarters

While the 2010 CFU operation universe did not include returns from group quarters (GQ), it was soon discovered during production that some HU returns sent to CFU were actually completed by persons in GQs. This was not due to a programming error; rather, a GQ facility may have been incorrectly identified as a HU and given HU returns. The telephone number on these returns connected the interviewer to a receptionist, and if multiple returns were sent to CFU from that GQ, the receptionist received many calls. In addition, these calls were often not forwarded to the appropriate respondent. As a result of these complications, it was determined that any case that shared a phone number with four or more other cases would be automatically pulled from the dialer. After being pulled, the cases underwent clerical review to determine if they represented potential GQs or potential HUs. The potential HUs were reloaded into the dialer, and the potential GQs were placed on the operational Do Not Call list.

The universes of HUs and GQs may perhaps never be completely distinct, but a check of some kind should occur before these unproductive cases are sent to the dialer. A system similar to the impromptu clerical system implemented during the 2010 CFU operation or a check of the telephone numbers in the dialer against the telephone numbers in the GQ universe should be included in any future telephone followup operations.

5.3 Telephone Lookup

Returns were sent to CFU regardless of the presence of a valid respondent-provided telephone number. As part of the CFU Verification process conducted by WCM, cases that had missing or invalid telephone numbers were processed through a Telephone Lookup in an external database to try to assign a valid phone number with which to contact a housing unit. During this process, up to three phone numbers could be appended to the case.

The external database was comprised of two commercial datasets (InfoUSA and QAS, formerly QuickAddress) that were linked with the Master Address File (MAF). These two commercial datasets were initially obtained for a different DRIS purpose (regarding data capture quality) but then leveraged for the CFU Telephone Lookup. Similarly, the external database also was built for paper data capture purposes.

A total of 865,947 cases were processed through Telephone Lookup; these cases had missing or invalid telephone numbers. Of these, 679,362 cases were unable to obtain a valid phone number via the Telephone Lookup process (which excluded cell phone numbers). Upon examination of the 186,566 cases that were successfully assigned a phone number and passed CFU Verification, these cases were not as likely to complete the interview as cases where the respondent provided the telephone number.

While the Telephone Lookup process did have a 78.5 percent failure rate, this could have been due to the designed process. Since the two commercial datasets were purchased for paper data

capture needs and the external database was also designed for such purposes, the success of the Telephone Lookup process could have been better if the databases had been tailored for the CFU purposes. For example, linking a Census ID to a phone number may have been more successful than the actual operational practice of linking a Census ID to an address to then link the address to a phone number.

5.4 Dialer Analysis

The dialer was analyzed as completely as possible by using reports generated by DRIS staff. These reports, however, rely on the same data source as the CDR and likely have similar issues as any original analysis from the CDR may have had. Readers are seriously cautioned when using any dialer results presented in this report.

During CFU Verification and the call loading process after cases were sent to DRIS, some cases failed to load into the dialer due to data issues or invalid telephone numbers. Table 23 shows the number of cases sent to DRIS and the number of cases that were loaded into the dialer by wave. The percent of cases that failed in each wave sharply increased in later waves because a higher proportion of the cases came from an initial enumerator form; enumerators may have been more likely to gather incomplete, invalid, or proxy telephone numbers. Out of the 8,053,068 cases sent to DRIS, 7,372,087 were loaded into the dialer. For the distribution of reasons that a case may have failed to have been loaded into the dialer, see Appendix B: Additional Dialer Table.

Table 23: Cases in the Dialer by Wave[22]

Wave	Number of Cases Sent to DRIS	Number of Cases that Failed Verification	Percent Failed	Number of Cases in the Dialer
1	974,024	68,006	7.0	906,020
2	936,728	61,696	6.6	875,032
3	786,900	51,426	6.5	735,476
4	865,585	50,321	5.8	815,264
5	1,077,207	61,735	5.7	1,015,473
6	900,621	56,922	6.3	843,700
7	429,347	30,914	7.2	398,433
8	484,388	54,060	11.2	430,329
9	1,225,377	142,556	11.6	1,082,824
10	286,028	74,135	25.9	211,895
11	86,863	29,222	33.6	57,641
Total[23]	**8,053,068**	**680,993**	**8.5**	**7,372,087**

Source: Phase III Deliverables

Table 24 shows the number of cases in the dialer by language campaign as the case was initially identified. As shown, 94.7 percent of the cases in the dialer were in the English campaign. The

---

[22] All tables and numbers in the dialer analysis include all cases sent to CFU.

[23] Sixteen cases were sent to DRIS twice. As a result, the total number of sent cases in this dialer section is sixteen more than the total number of cases in the workload section. Three of these cases were sent in Wave 8 and thirteen were sent in Wave 9.

volume of the Chinese, Korean, Russian, and Vietnamese campaigns were all under 0.1 percent. As the operation continued, these campaigns would gain volume through cases dispositioned as Language Barrier cases from other campaigns, especially English.

Table 24: Number of Cases in the Dialer by Language

Language	Number of Cases in the Dialer	Percent of Total Cases
English	6,977,727	94.7
Spanish	393,924	5.3
Chinese	217	0.0
Korean	106	0.0
Russian	19	0.0
Vietnamese	94	0.0
Total	**7,372,087**	**100.0**

Source: Phase III Deliverables

During the CFU operation, there were 45,145,974 total dial attempts and 17,605,691 total connects. A contact or a connect is defined as a call that was connected with an interviewer upon the dialer detecting certain dial tones or a person's voice, either on outbound or inbound calls; this was different from a dial, which was any outbound attempt made by the dialer to reach a respondent and which could result in a connect or in a dialer-specific disposition.

Upon reaching an answering machine, the dialer was designed to leave an automatic message with relevant contact information and a unique case identifier. To ensure that the dialer would not misinterpret some dial tones as an answering machine instead of a live respondent, the dialer was programmed to pass the call to an interviewer if an ambiguous tone was reached. As a result, some answering machines were reached by interviewers. Interviewers were able to leave a message similar to the dialer's automatic message. Table 25 shows that interviewers left 28.6 percent of the total answering machine messages.

Table 25: Number of Messages Left by Source

Source	Number of Messages	Percent
Agent Left	5,024,397	28.6
Dialer Left	12,527,082	71.4
Total	**17,551,479**	**100.0**

Source: Phase III Deliverables

After being loaded in the dialer, the cases were dialed and interviews were attempted. If all residence questions presented during the interview were answered, then the case was considered completed. Not all cases were completed; the overall completion rate of all cases in the dialer was 66.0 percent, and the overall completion rate of all cases sent to DRIS was 60.4 percent. Table 26 shows the completion rate by source of coverage improvement. The overcount category "in college housing" has the highest completion rate at 71.7 percent, and overcount category "in a nursing home" has the lowest completion rate at 55.0 percent.

Table 26: Cases Received and Completed by Bucket[24]

Bucket	Number of Cases in Dialer	Number of Cases Completed	Percent Complete
Large Household	1,139,938	792,258	69.5
Count Discrepancies	1,708,056	1,087,016	63.6
High	1,177,668	788,892	67.0
Low	530,388	298,124	56.2
Undercount	1,643,757	1,033,679	62.9
Children	282,534	164,975	58.4
Relatives	673,154	425,831	63.3
Nonrelatives	204,966	123,602	60.3
People staying temporarily	483,103	319,271	66.1
Overcount	1,989,044	1,366,441	68.7
In college housing	831,446	596,120	71.7
In the military	449,171	307,184	68.4
In jail or prison	64,444	38,241	59.3
In a nursing home	71,147	39,105	55.0
Person multiple	161,539	106,334	65.8
Household multiple	411,297	279,457	67.9
Administrative Records	492,114	332,246	67.5
Other Sources[25]	399,178	253,972	63.3
Total	**7,372,087**	**4,865,612**	**66.0**

Source: Phase III Deliverables

The CFU operation allowed for both outbound and inbound calls. A respondent could call a CFU interviewer if a message was left on their answering machine, if the previous contact was a language barrier disposition, or if the respondent indicated that he or she would prefer to contact an interviewer at his or her convenience. Table 27 shows the number of contacts and completions in each direction. While only 11.9 percent of the contacts were inbound contacts, 28.4 percent of the completed cases were completed on an inbound call. This makes sense because an inbound caller would likely be more prepared to complete the interview than a respondent contacted unexpectedly.

---

[24] Cases sent to DRIS were in buckets, which were unique groupings of cases based on source of coverage improvement. Even though this table looks similar to other tables in this report, the rows in this table are unduplicated while the rows in most other tables dealing with sources of coverage improvement in this report are not. Please use caution when comparing this table to other tables in this report.

[25] This category is composed of the Evaluation, Unduplication, and Research returns also included in CFU but not within the scope of this assessment.

Table 27: Number of Contacts and Completes by Direction

Direction	Number of Contacts	Percent of Contacts	Number of Completes	Percent of Completes
Inbound	2,092,879	11.9	1,381,198	28.4
Outbound	15,512,812	88.1	3,483,518	71.6
Total	**17,605,691**	**100.0**	**4,864,716**[26]	**100.0**

Source: Phase III Deliverables

5.5 Operational Results

This section looks at various characteristics of completed CFU interviews. Since the CFU interview primarily attempts to resolve coverage issues, much of this section examines cases with added or deleted roster members. An added roster member is one who a CFU respondent identified as missing from the household roster during the CFU interview and who was coded as a resident at that housing unit after answering subsequent living situation probes in the CFU interview. A deleted roster member is one who a CFU respondent identified as a duplicate of someone else on the roster or as an unknown person during the CFU interview or a roster member who was coded as a non-resident after answering living situation probes in the CFU interview. Persons who respondents identified as missing from the roster but who were coded as non-residents are not considered deleted roster members and are not included in this report.

In addition, the demographic item non-response rate for existing and added roster members is included in this section.

This operational results analysis is limited to cases with at least one production source of coverage improvement. For cases with only evaluation sources of coverage improvement, please see the Evaluation of Administrative Records Use for Coverage Problems and the Evaluation of Administrative Records Use for Coverage Problems. Also, cases that were completed in Module B were not returned to HQP and will not be included in any tables in this section. Thus, the number of completed cases in this section of the report will differ from the number of completed cases in previous sections of this report.

5.5.1 Completed CFU Cases with Added or Deleted Persons[27]

Table 28 provides an overall view of the added and deleted persons both across the operation and across the census. Since multiple CFU interviews were associated with some Census IDs, this assessment looks at the last, most complete interview and counts the number of persons added and deleted in that interview, as shown in the "Across CFU" row. Post-operational processing, though, may have selected a different completed interview as the gold-plated interview for the corresponding MAFID or may have deleted the housing unit if the updated MAFID of a CFU return matched to the MAFID of a deleted housing unit. The "Across the Census" row contains

---

[26] Due to differing data sources for this table and for Table 26, the total number of completes do not match. Since the proportions presented in this table are of the most interest, the conflicting number of completions are retained here; please use caution whenever reading dialer numbers.
[27] For more information about the creation of the CFU universe, please refer to Section 3.2.

the counts of added and deleted roster members of housing units selected by PSA. Because this assessment may not have selected the same CFU interview for analysis that was selected in post-operational processing, the number of added and deleted persons may not be the same between the two approaches. Table 28 shows how the counts compare. Throughout the results section, all numbers will be operation-based, not census-based. This assessment, therefore, will report slightly more added and deleted persons than what may be seen on a census level.

Table 28: Operational and Census Add and Delete Rates

	Percent of CFU Cases with an Added Person	Number of Added People	Percent of CFU Cases with a Deleted Person	Number of Deleted People	Net Impact
Across CFU	5.4	350,901	22.2	1,235,096	-884,195
Across the Census[28]	5.5	350,444	22.5	1,234,235	-883,791

Source: CFU Analysis File

The purpose of the CFU interview is to improve coverage, so we are especially interested in the number of housing units with roster changes as well as the number of people added or deleted overall. Table 29 through Table 61 display roster changes by salient variables. Due to the way that AR cases were processed, any case in waves one through seven that would have been flagged as an AR case did not have an AR flag on the DRF. For this report, the flags were recovered using files generated during the AR matching process in production. In these tables, any case that met the AR definition of having at least 0.20 expected missing persons – particularly the cases in waves one through seven – is labeled as an AR case.

5.5.1.1 Added or Deleted Persons by Household Variables

Table 29 shows the number of housing units with added or deleted persons by the different sources of coverage improvement. Since this table counts cases that have multiple sources of coverage improvement in each of the source's rows, refer to the overlap analysis section for a different view of the data.

Out of 4,536,636[29] completed cases, 27.1 percent had at least one added or deleted person. A total of 1,585,997 people were added or deleted in CFU. The source of coverage improvement that showed the highest percentage of housing units with an added or deleted person was the overcount category "in college housing" with 74.9 percent. The results in Table 29 are expected based on the 2005 National Census Test (NCT).

---

[28] The numbers in this row come from cases flagged by PSA as the gold-plated CFU return.

[29] The number of completed cases in the operational results will not match the number of completed cases in the dialer results because the dialer results included cases with non-production sources of coverage improvements as well as cases completed in Module B. Returns from cases completed in Module B were not included in post-operational processing and did not impact census counts.

Table 29: Households with Added or Deleted People by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Cases Completed in CFU	Number of Cases with Added or Deleted People	Percent of Completed Cases	Number of Added or Deleted People
Large Households	897,735	105,078	11.7	186,736
Count Discrepancies	1,066,382	370,939	34.8	520,147
High	778,642	267,871	34.4	355,361
Low	287,740	103,068	35.8	164,786
Undercount	1,350,368	259,580	19.2	343,298
Children	216,041	44,900	20.8	61,864
Relatives	557,319	107,514	19.3	139,884
Nonrelatives	151,182	24,759	16.4	32,271
People staying temporarily	425,826	82,407	19.4	109,279
Overcount	1,534,063	750,316	48.9	897,799
In college housing	675,734	506,421	74.9	581,561
In the military	322,210	67,939	21.1	74,101
In jail or prison	46,478	4,487	9.7	5,859
In a nursing home	47,034	23,927	50.9	26,063
Person multiple	107,748	22,066	20.5	28,029
Household multiple	334,859	125,476	37.5	182,186
Administrative Records	391,637	30,510	7.8	47,985
Unduplicated Total	**4,536,636**	**1,227,945**	**27.1**	**1,585,997**

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

Even though AR cases were sent to CFU due to suspected missing persons, the percent of cases with AR as a source of coverage improvement that added or deleted a roster member was 7.8 percent. Table 40 will further show that of completed cases with AR as a source of coverage improvement, only 4.1 percent added a roster member. When looking at cases with AR as the only source of coverage improvement in Table 65, the percent of completed cases that added a roster member drops to 2.8 percent. This result is in line with the 2005 NCT findings, where 3.9 percent of cases with a source of coverage improvement of only AR added a roster member (Sheppard et al., 2007)[30]. Some additional analysis showed that during the interviews of AR cases, a high percentage of potential roster members that respondents attempted to add but were found to not be true residents were not added because the potential roster member was away for college.

After the production period ended, an unexpected logical pathway was discovered in the algorithm that determined if a roster member should be kept, added, or removed from a

---

[30] The administrative records cases in the 2005 National Census Test were not selected using the same methodology as the AR cases were selected in the 2010 CFU operation. In the 2005 National Census Test, the cutoff that was used in the 2010 CFU operation was still being developed, so 3,000 AR cases were selected for followup in the 2005 National Census Test by a probability proportionate to size method.

household. Due to incorrect programming, all persons who should have been deleted from a roster due to being in a correctional facility, an emergency shelter, a group home, or some other group quarter on Census Day remained residents. If a person was identified for deletion for one of these reasons in addition to another reason (e.g., college, nursing home), then the person was successfully deleted from the roster. Since a CFU source of coverage improvement was the overcount category "in jail or prison," this error affected the roster change rate for that source. Consequently, 33,407 fewer cases saw an added or deleted person and 44,228 fewer people were added or deleted than expected. Since people respondents attempted to add to the roster were subject to the same residence coding as people who already existed on the original roster, the error causes more people to be added and fewer people to be deleted than expected. This error was not corrected prior to the release of the 2010 census count; as a result, any of these people who were also counted at the GQ mentioned in the CFU interview may have remained duplicated in the final census count. Table 30 shows the number of added or deleted people by source of coverage improvement with the logic implemented as initially expected. While most categories show a slight increase in the number of added or deleted people, the percent of households in the overcount category "in jail or prison" with an added or deleted person increases from 9.7 percent to 44.6 percent. The rest of this assessment will include numbers from the algorithm used in production (as shown in Table 29).

Table 30: Households by Source of Coverage Improvement – Alternative Coding

Source of Coverage Improvement*	Number of Cases Completed in CFU	Number of Cases with Added or Deleted People	Percent of Completed Cases	Number of Added or Deleted People
Large Households	897,735	110,690	12.3	196,973
Count Discrepancies	1,066,382	380,653	35.7	533,381
High	778,642	277,027	35.6	367,344
Low	287,740	103,626	36.0	166,037
Undercount	1,350,368	266,769	19.8	352,833
Children	216,041	45,730	21.2	63,023
Relatives	557,319	111,167	19.9	144,406
Nonrelatives	151,182	25,492	16.9	33,538
People staying temporarily	425,826	84,380	19.8	111,866
Overcount	1,534,063	774,186	50.5	927,506
In college housing	675,734	506,833	75.0	582,350
In the military	322,210	68,207	21.2	74,454
In jail or prison	46,478	20,720	44.6	24,105
In a nursing home	47,034	24,823	52.8	27,072
Person multiple	107,748	22,868	21.2	28,966
Household multiple	334,859	130,735	39.0	190,559
Administrative Records	391,637	31,205	8.0	48,884
Unduplicated Total	**4,536,636**	**1,261,352**	**27.8**	**1,630,225**

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

CFU conducted interviews in six languages. If the language of a return sent to CFU was one of these six languages, the case was automatically handled by an interviewer in that language. Otherwise, the case was handled by an English interviewer. At the beginning of any call, the respondent could request that the interview continue in any of the six CFU languages. Table 31 shows the distribution of people added or deleted from cases completed in each of these languages. Interview language was self-reported by the interviewer, and "Other" was an option. Cases with language of "Other" could be a result of the interviewer selecting an incorrect category. Some of the completed CFU returns had no value for interview language, and these are labeled as "Missing."

Table 31: Households with Added or Deleted People by Interview Language

Interview Language	Number of Cases Completed in CFU	Number of Cases with Added or Deleted People	Percent of Completed Cases	Number of Added or Deleted People
English	4,103,862	1,154,388	28.1	1,476,431
Spanish	393,266	64,958	16.5	97,230
Chinese	16,502	3,682	22.3	5,177
Korean	4,983	1,613	32.4	2,123
Russian	3,546	546	15.4	757
Vietnamese	9,853	1,762	17.9	2,758
Other*	1,342	332	24.7	434
Missing	3,282	664	20.2	1,087
Total	**4,536,636**	**1,227,945**	**27.1**	**1,585,997**

Source: CFU Analysis File
*Interview language was reported by the interviewer, and one option was a language of "Other."

When compared to the distribution of language cases sent to CFU, as seen in Table 32, the proportion of cases that completed in English – while still the highest – is less than the proportion of cases that were sent to CFU in English.

Table 32: Comparison of Language Distribution of Sent Cases and Completed Cases

Language	Percent of Total Sent Cases in Language Group*	Percent of Total Completed Cases by Language Completed**
English	94.4	90.5
Spanish	5.6	8.7
Chinese	0.0	0.4
Korean	0.0	0.1
Russian	0.0	0.1
Vietnamese	0.0	0.2
Other	N/A	0.0
Missing	N/A	0.1
Total	100.0 (n=8,053,052)	100.0 (n=4,536,636)

Source: CFU Analysis File

*The total number of cases sent includes non-production sources of coverage improvement.
**The total number of cases completed does not include non-production sources of coverage improvement.

Most form types were eligible for CFU, and Table 33 shows the addition and deletion rates by eligible form type. While the 2000 CEFU universe did not include initial returns completed by enumerators because one could expect that enumerators would solve coverage problems with the respondent, a higher percentage of completed enumerator returns had a person added or deleted from the roster than did respondent-completed returns in the 2010 CFU operation. This difference between the two modes of gathering responses was noticed in the 2004 National Census Test (Krejsa et al, 2005).

Table 33: Households with Added or Deleted People by Form Type

Form Type	Number of Cases Completed in CFU	Number of Cases with Added or Deleted People	Percent of Completed Cases	Number of Added or Deleted People
Respondent-Provided	4,153,785	1,113,531	26.8	1,435,537
MO/MB – English	3,612,845	1,002,847	27.8	1,278,920
MO/MB -- Bilingual	491,421	100,871	20.5	142,921
MO/MB -- Fulfillment	10,173	1,273	12.5	2,106
U/L -- English Stateside	294	68	23.1	98
U/L -- Puerto Rico	39,052	8,472	21.7	11,492
Enumerator-Provided	382,851	114,414	29.9	150,460
TQA	635	147	23.1	187
NRFU	370,641	110,404	29.8	145,190
U/E	11,575	3,863	33.4	5,083
Total	**4,536,636**	**1,227,945**	**27.1**	**1,585,997**

Source: CFU Analysis File

5.5.1.2 Added or Deleted Persons by Demographic Variables[31]

There were 1,208,584 households with an added or deleted data-defined person for a total of 1,554,815 added or deleted data-defined persons included on 4,536,636 CFU forms in the 2010 Census. All added or deleted persons are defined as such by the final status given during residence coding; roster members that respondents attempted to add or delete but who were ultimately not added or deleted based on all information collected in the CFU operation are not considered as added or deleted persons in this report. While a person could not be added to the roster without being data-defined, all non-data-defined persons were deleted from the roster. Non-data-defined deleted roster members are not included in any demographic tables, but they are included in non-demographic tables. Thus, the number of added or deleted persons in the demographic tables is less than the number of added or deleted roster members in the non-demographic tables. Also, the CFU return is the only source of demographic data for added

---

[31] All tables in this section contain frequencies on unimputed and unedited demographic data.

roster members while a combination of the CFU return and the initial return sent to CFU are the sources of demographic data for deleted roster members. See Appendix C: Standard Demographic Tables for demographic tables for all people on completed CFU returns.

Table 34 shows the ages of roster members added or deleted in the CFU interview. Age was calculated based on the date of birth provided; if no date of birth was provided then the write-in age was used.   Age was calculated only if the date of birth fell within valid date ranges. Similarly, the calculated age or write-in age was used only if it fell within valid age ranges; otherwise, it was considered missing. Of the added and deleted roster members, 21.6 percent were between the ages of 15 to 19 years, and 30.8 percent were between the ages of 20 and 24 years. This could be due to the high deletion rates of college students.

Table 34: Added or Deleted People by Age

Age	Number of Added or Deleted People	Percent of Added or Deleted People
Under 5 years	82,167	5.3
5 to 9 years	61,037	3.9
10 to 14 years	66,584	4.3
15 to 19 years	335,124	21.6
20 to 24 years	478,407	30.8
25 to 29 years	76,746	4.9
30 to 34 years	45,491	2.9
35 to 39 years	39,173	2.5
40 to 44 years	38,055	2.4
45 to 49 years	40,897	2.6
50 to 54 years	42,959	2.8
55 to 59 years	39,536	2.5
60 to 64 years	37,123	2.4
65+ years	129,198	8.3
Missing	42,318	2.7
Total	**1,554,815**	**100.0***

Source: CFU Analysis File
* Percentages do not sum to 100 percent due to rounding

Table 35 shows the Hispanic origin of added or deleted roster members. Of the added or deleted roster members, 81.4 percent selected only the "Not Hispanic or Latino" checkbox.

Table 35: Added or Deleted People by Hispanic Origin

Hispanic Origin	Number of Added or Deleted People	Percent of Added or Deleted People
Not Hispanic or Latino checkbox only	1,265,130	81.4
Mexican checkbox only	105,263	6.8
Puerto Rican checkbox only	30,411	2.0
Cuban checkbox only	6,504	0.4
Another Hispanic checkbox only	3,728	0.2
Multiple checkboxes	2,969	0.2
Both Checkbox and Write-in	59,963	3.9
Write-in Only	12,912	0.8
Missing	67,935	4.4
Total	**1,554,815**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 36 shows the race checkbox selected by added or deleted roster members. The "White" checkbox alone was selected by 65.7 percent of the added or deleted roster members.

Table 36: Added or Deleted People by Race

Race	Number of Added or Deleted People	Percent of Added or Deleted People
White checkbox alone	1,020,768	65.7
Black or African American checkbox alone	204,696	13.2
American Indian and Alaska Native checkbox alone	2,539	0.2
Asian Indian checkbox alone	18,281	1.2
Chinese checkbox alone	23,836	1.5
Filipino checkbox alone	13,065	0.8
Japanese checkbox alone	2,955	0.2
Korean checkbox alone	9,674	0.6
Vietnamese checkbox alone	7,701	0.5
Other Asian checkbox alone	346	0.0
Native Hawaiian checkbox alone	1,082	0.1
Guamanian or Chamorro checkbox alone	350	0.0
Samoan checkbox alone	553	0.0
Other Pacific Islander checkbox alone	66	0.0
Some Other Race checkbox alone	1,707	0.1
Multiple checkboxes	26,073	1.7
Both Checkbox and Write-in	140,347	9.0
Write-in Only	14,836	1.0
Missing	65,940	4.2
Total	**1,554,815**	**100.0**

Source: CFU Analysis File

Table 37 shows the relationship checkbox selected by added or deleted roster members. Of these roster changes, 52.9 percent selected only the "Biological Son or Daughter of Householder" checkbox. This could also be due to the high deletion rates of college students.

Table 37: Added or Deleted People by Relationship*

Relationship	Number of Added or Deleted People	Percent of Added or Deleted People
Householder	126,778	8.2
Husband or Wife of Householder	111,802	7.2
Biological Son or Daughter of Householder	821,974	52.9
Adopted Son or Daughter of Householder	19,549	1.3
Stepson or Stepdaughter of Householder	48,602	3.1
Brother or Sister of Householder	26,269	1.7
Father or Mother of Householder	31,935	2.1
Grandchild of Householder	72,379	4.7
Parent-in-law of Householder	12,986	0.8
Son-in-law or Daughter-in-law of Householder	10,286	0.7
Other Relative	57,528	3.7
Related**	13,975	0.9
Roomer or Boarder	18,920	1.2
Housemate or Roommate	24,733	1.6
Unmarried Partner	19,244	1.2
Other Nonrelative	83,324	5.4
Not Related**	4,536	0.3
Two or more relationships	2,176	0.1
Missing	47,819	3.1
Total	**1,554,815**	**100.0***

*The definition of the relationship categories differs slightly from the definitions for the standard demographic tables. Since responses to the Related and Not Related question on the returns sent to CFU persisted in the returns from CFU, a person was given a relationship category first by ignoring these two responses and then including them if no other relationship response was given in CFU. The standard demographic definition is used in Appendix C: Standard Demographic Tables, so care should be taken when comparing relationship tables in this report.
**This relationship category is not found on TQA or CFU returns
*** Percentages do not sum to 100 percent due to rounding
Source: CFU Analysis File

Table 38 shows the checkbox selected by added or deleted roster members for the sex question. At 51.0 percent, slightly more added or deleted persons selected the "Male" checkbox only.

Table 38: Added or Deleted People by Sex

Sex	Number of Added or Deleted People	Percent of Added or Deleted People
Male	792,437	51.0
Female	738,380	47.5
Both	1,584	0.1
Missing	22,414	1.4
Total	**1,554,815**	**100.0**

Source: CFU Analysis File

Table 39 shows the tenure checkbox selected for households with added or deleted roster members. At 60.9 percent, the "Owned with a mortgage or a loan" checkbox was selected more times than any other field.

Table 39: Households with Added or Deleted People by Tenure

Tenure	Number of Cases with Added or Deleted People	Percent of Cases with Added or Deleted People
Owned with a mortgage or a loan	736,374	60.9
Owned without a mortgage or a loan	195,241	16.2
Rented	251,044	20.8
Occupied without payment of rent	18,303	1.5
Multiple	5,295	0.4
Missing	2,327	0.2
Total	**1,208,584**	**100.0**

Source: CFU Analysis File

5.5.2   Completed CFU Cases with Added Persons

5.5.2.1 Added People by Household Variables

Cases that had a source of coverage improvement of LHH, low count discrepancy, undercount, or AR were sent to CFU because of suspected missing persons. Table 40 shows the number of households with added persons by source of coverage improvement. At 31.2 percent, low count discrepancy cases added people the most often, which is expected of the case type. Undercount cases resulted in an added person 7.8 percent of the time. Of the undercount case types, "relatives" did not perform quite as well as the others, but this may be attributable to respondents indicating that they did not count a family member away at college.

Table 40: Households with an Added Person by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Cases Completed in CFU	Number of Cases with an Added Person	Percent of Completed Cases	Number of Added Persons
Large Households	897,735	38,474	4.3	65,259
Count Discrepancies	1,066,382	111,105	10.4	171,682
High	778,642	21,435	2.8	28,607
Low	287,740	89,670	31.2	143,075
Undercount	1,350,368	105,002	7.8	138,669
Children	216,041	18,334	8.5	25,403
Relatives	557,319	32,626	5.9	43,546
Nonrelatives	151,182	11,743	7.8	14,946
People staying temporarily	425,826	42,299	9.9	54,774
Overcount	1,534,063	26,654	1.7	34,393
In college housing	675,734	9,301	1.4	11,874
In the military	322,210	4,435	1.4	5,615
In jail or prison	46,478	1,787	3.8	2,385
In a nursing home	47,034	892	1.9	1,179
Person multiple	107,748	2,126	2.0	2,781
Household multiple	334,859	8,113	2.4	10,559
Administrative Records[32]	391,637	16,086	4.1	28,219
Unduplicated Total	**4,536,636**	**246,241**	**5.4**	**350,901**

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

In the CFU interview, a respondent could add a roster member at seven different probe questions. All seven questions were asked in every CFU interview, no matter a case's source of coverage improvement. Table 41 shows the distribution of persons added at each probe. Over half of the added persons were added at the "Other relatives" probe.

---

[32] See 5.5.1.1 for discussion about AR cases.

Table 41: Number of People Added by "Missing" Probe Category

Missing Probe	Number of People Added	Percent of People Added
Infants or newborns	34,177	9.7
Foster children	10,364	3.0
Non-related children	12,288	3.5
Other relatives	197,298	56.2
Roommates	54,328	15.5
People who stay often	30,768	8.8
People with no other place to stay	7,411	2.1
Unknown*	4,267	1.2
Total	**350,901**	**100.0**

Source: CFU Analysis File and Aux

*Due to looping interview navigation, the probe category was irretrievable for some added persons

Table 42 shows the interview language of households with added persons. While 7.4 percent of completed Korean interviews added a roster member, the overall average of 5.4 percent is driven by the high percentage of cases completed in English.

Table 42: Households with an Added Person by Interview Language

Interview Language	Number of Cases Completed in CFU	Number of Cases with an Added Person	Percent of Completed Cases	Number of Added Persons
English	4,103,862	220,721	5.4	306,148
Spanish	393,266	23,007	5.9	40,372
Chinese	16,502	923	5.6	1,614
Korean	4,983	368	7.4	555
Russian	3,546	203	5.7	301
Vietnamese	9,853	655	6.6	1,222
Other	1,342	58	4.3	92
Missing	3,282	306	9.3	597
Total	**4,536,636**	**246,241**	**5.4**	**350,901**

Source: CFU Analysis File

While CFU interviews from respondent-provided census returns resulted in more added roster members than did CFU interviews from enumerator-provided census returns, enumerator forms added roster members more often than respondent forms. Table 43 shows the full picture.

Table 43: Households with an Added Person by Form Type

Form Type	Number of Cases Completed in CFU	Number of Cases with an Added Person	Percent of Completed Cases	Number of Added Persons
Respondent-Provided	4,153,785	222,603	5.4	311,783
MO/MB -- English	3,612,845	191,525	5.3	262,094
MO/MB -- Bilingual	491,421	27,578	5.6	44,092
MO/MB -- Fulfillment	10,173	613	6.0	1,190
U/L -- English Stateside	294	16	5.4	23
U/L -- Puerto Rico	39,052	2,871	7.4	4,384
Enumerator-Provided	382,851	23,638	6.2	39,118
TQA	635	34	5.4	48
NRFU	370,641	22,897	6.2	37,963
U/E	11,575	707	6.1	1,107
Total	**4,536,636**	**246,241**	**5.4**	**350,901**

Source: CFU Analysis File

5.5.2.2 Added People by Demographic Variables[33]

There were 246,241 households with an added data-defined person for a total of 350,901 added data-defined persons included on 4,536,636 CFU forms in the 2010 Census. Table 44 shows the age distribution of persons added to the roster. The "Under 5 years" group saw the highest percentage of added people with 15.6 percent. This could be attributed to the fact that one undercount category specifically probes for missing newborns or babies while the other undercount categories do not mention a specific age group.

---

[33] All tables in this section contain frequencies on unimputed and unedited demographic data.

Table 44: Added People by Age

Age in Years	Number of Added People	Percent of Added Persons
Under 5 years	54,695	15.6
5 to 9 years	25,699	7.3
10 to 14 years	22,301	6.4
15 to 19 years	34,212	9.7
20 to 24 years	38,125	10.9
25 to 29 years	26,586	7.6
30 to 34 years	17,479	5.0
35 to 39 years	14,120	4.0
40 to 44 years	13,729	3.9
45 to 49 years	14,338	4.1
50 to 54 years	14,624	4.2
55 to 59 years	12,654	3.6
60 to 64 years	11,564	3.3
65+ years	35,640	10.2
Missing	15,153	4.3
Total	**350,901**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 45 shows the Hispanic origin checkbox selected for added roster members. With 73.3 percent of added roster members, the "Not Hispanic or Latino" checkbox was selected most often.

Table 45: Added People by Hispanic Origin

Hispanic Origin	Number of Added Persons	Percent of Added Persons
Not Hispanic or Latino checkbox only	257,216	73.3
Mexican checkbox only	46,393	13.2
Puerto Rican checkbox only	9,522	2.7
Cuban checkbox only	1,429	0.4
Another Hispanic checkbox only	247	0.1
Multiple checkboxes	380	0.1
Both Checkbox and Write-in	19,309	5.5
Write-in Only	1,701	0.5
Missing	14,704	4.2
Total	**350,901**	**100.0**

Source: CFU Analysis File

Table 46 shows the race checkbox selected by added roster members. With 52.7 percent of the added persons, the "White" race checkbox alone was selected most often.

Table 46: Added People by Race

Race	Number of Added People	Percent of Added Persons
White checkbox alone	184,791	52.7
Black or African American checkbox alone	63,216	18.0
American Indian and Alaska Native checkbox alone	791	0.2
Asian Indian checkbox alone	4,385	1.2
Chinese checkbox alone	5,650	1.6
Filipino checkbox alone	3,712	1.1
Japanese checkbox alone	984	0.3
Korean checkbox alone	2,145	0.6
Vietnamese checkbox alone	2,488	0.7
Other Asian checkbox alone	41	0.0
Native Hawaiian checkbox alone	633	0.2
Guamanian or Chamorro checkbox alone	106	0.0
Samoan checkbox alone	272	0.1
Other Pacific Islander checkbox alone	9	0.0
Some Other Race checkbox alone	939	0.3
Multiple checkboxes	5,221	1.5
Both Checkbox and Write-in	55,802	15.9
Write-in Only	2	0.0
Missing	19,714	5.6
Total	**350,901**	**100.0**

Source: CFU Analysis File

Table 47 shows the relationship of added roster members to the householders. Householders were not permitted to be added during the CFU interview, and only one relationship checkbox was allowed to be selected. The "Related" and "Not Related" checkboxes were not available in the CFU interview but are included in all other relationship tables in this report and are thus included here. Respondents selected only the "Biological Son or Daughter" checkbox for 24.4 percent of added roster members.

Table 47: Added People by Relationship*

Relationship	Number of Added People	Percent of Added Persons
Householder**	0	0.0
Husband/Wife of Householder	31,204	8.9
Biological Son or Daughter of Householder	85,689	24.4
Adopted Son or Daughter of Householder	2,824	0.8
Stepson or Stepdaughter of Householder	6,253	1.8
Brother or Sister of Householder	12,411	3.5
Father or Mother of Householder	16,155	4.6
Grandchild of Householder	36,574	10.4
Parent-in-law of Householder	8,281	2.4
Son-in-law or Daughter-in-law of Householder	5,096	1.5
Other Relative	37,692	10.7
Related***	0	0.0
Roomer or Boarder	12,908	3.7
Housemate or Roommate	14,623	4.2
Unmarried Partner	6,438	1.8
Other Nonrelative	59,053	16.8
Not Related***	0	0.0
Two or more relationships	0	0.0
Missing	15,700	4.5
Total	**350,901**	**100.0**

*The definition of the relationship categories differs slightly from the definitions for the standard demographic tables. Since responses to the Related and Not Related question on the returns sent to CFU persisted in the returns from CFU, a person was given a relationship category first by ignoring these two responses and then including them if no other relationship response was given in CFU. The standard demographic definition is used in Appendix C: Standard Demographic Tables, so care should be taken when comparing relationship tables in this report.
** This relationship category is not explicitly found on any return and is meant to identify the reference person for whom all other household members use to define relationship. The householder is usually Person 1 on the household roster.
***This relationship category is not found on CFU or TQA returns
Source: CFU Analysis File

Added roster members were nearly evenly divided between the two sex checkboxes marked; 50.4 percent selected "Male" and 48.4 percent selected "Female." The CFU interview did not allow both sex checkboxes to be selected. Table 48 shows the distribution.

Table 48: Added People by Sex

Sex	Number of Added Persons	Percent of Added Persons
Male	176,794	50.4
Female	169,731	48.4
Both	0	0.0
Missing	4,376	1.2
Total	**350,901**	**100.0**

Source: CFU Analysis File

Table 49 shows the response to the tenure question of households with added persons. At 50.9 percent of households with added people, more households selected only the "Owned with a mortgage or a loan" checkbox than any other.

Table 49: Households with Added People by Tenure

Tenure	Number of Cases with an Added Person	Percent of Cases with Added People
Owned with a mortgage or a loan	125,337	50.9
Owned without a mortgage or a loan	39,706	16.1
Rented	72,970	29.6
Occupied without payment of rent	5,478	2.2
Multiple	1,690	0.7
Missing	1,060	0.4
Total	**246,241**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

5.5.2.3 Additional People that Respondents Attempted to Add

Not all people that respondents mentioned as missing from the household were added to the final roster. Interviewers were instructed to add anyone mentioned by respondents, but responses to living situation probes could be used to remove both existing as well as added roster members. Since people added to the roster but subsequently removed from it did not affect the final household roster or any official Census counts, they were not included in the previous tables about added roster members or in the following tables about deleted roster members. This section addresses the characteristics of these attempted adds.

Table 50 shows the people attempted to be added but ultimately removed from the roster by probe category. Since roster members could be deleted by roster review and the variable for removal by roster review was the same for the add probe, there is a higher percentage of people who were added at an unknown probe (26.0 percent) than there was for added people who remained on the final roster (1.2 percent). The probe that most often solicited an attempt to add a roster member was "Other Relatives," which is comparable to the result in Table 41. Despite the high proportion of attempted adds with an unknown probe category, the proportion of people added at the "People who stay often" probe is much higher than that in Table 41 (8.8 percent).

Table 50: Number of People Attempted to be Added by "Missing" Probe Category

Missing Probe	Number of Attempted Adds	Percent of Attempted Adds
Infants or Newborns	8,364	7.7
Foster Children	533	0.5
Non-related Children	1,456	1.3
Other relatives	46,851	43.0
Roommates	4,220	3.9
People who stay often	18,010	16.5
People with no other place to stay	1,302	1.2
Unknown*	28,307	26.0
Total	**109,043**	**100.0**

Source: CFU Analysis File

*Due to looping interview navigation, the probe category was irretrievable for some added persons

Table 51 shows the distribution of the people attempted to be added to the roster but ultimately removed by probe category. Roster review categories indicate those who were identified by the respondent as unknown or duplicated when the interviewer read the household roster at the beginning of the interview. The rest of the categories correspond to questions in the interview that probe for roster members' alternate addresses. Due to complicated living situations, a roster member may have been deleted for multiple reasons, so these categories are not mutually exclusive. When compared with Table 53 for all deleted roster members, a lower percentage of attempted adds were removed from the roster due to a college living situation (26.8 percent) than were existing roster members (53.2 percent). Also, a higher percentage of attempted adds were removed from the roster due to child custody (16.2 percent) than were existing roster members (7.7 percent). This table also includes a "Not data defined" probe; this category is not technically a probe, but it instead represents the number of attempted adds who were not added to the roster because not enough demographic data were provided during the interview to be considered a data defined person. As Table 51 shows, 17.8 percent of attempted adds were not data defined.

Table 51: Number of People Attempted to be Added by Roster Review and "Living Situation" Probe

Roster Review or Living Situation Probe*	Number of Attempted Adds	Percent of Attempted Adds**
Roster review	16,224	14.9
Unknown person	13,727	12.6
Duplicated person	2,497	2.3
Moved	6,991	6.4
College	29,215	26.8
Child custody	17,686	16.2
Military	2,691	2.5
Job	3,466	3.2
Seasonal or second home	8,731	8.0
Other address	10,798	9.9
Group quarters	956	0.9
Born after Census Day	6,906	6.3
Not data defined	19,370	17.8
Unduplicated total	**109,043**	

Source: CFU Analysis File and Aux

* Probe categories are not mutually exclusive.

**Because the probe categories are not mutually exclusive, the number of deleted persons and the percent of deleted persons do not sum to 100 percent.

5.5.3   Completed CFU Cases with Deleted Persons

5.5.3.1 Deleted Roster Members by Household Variables

The CFU interview successfully deleted 1,235,096 roster members from all production cases. As seen in Table 52, 22.2 percent of completed cases deleted a roster member. The source of coverage improvement that saw the most households with deletes was the overcount "in college housing," which was expected based on the 2005 NCT CFU results (Sheppard et al, 2007). With the exception of the overcount category "in jail or prison", the rest of the overcount case types as well as the high count discrepancies case type had high delete rates (see Section 5.5.1.1 for information on coding error for this category).

Table 52: Households with a Deleted Person by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Cases Completed in CFU	Number of Cases with a Deleted Person	Percent of Completed Cases	Number of Deleted Persons
Large Households	897,735	71,028	7.9	121,477
Count Discrepancies	1,066,382	268,441	25.2	348,465
High	778,642	252,115	32.4	326,754
Low	287,740	16,326	5.7	21,711
Undercount	1,350,368	163,073	12.1	204,629
Children	216,041	27,925	12.9	36,461
Relatives	557,319	78,117	14.0	96,338
Nonrelatives	151,182	13,881	9.2	17,325
People staying temporarily	425,826	43,150	10.1	54,505
Overcount	1,534,063	735,062	47.9	863,406
In college housing	675,734	503,408	74.5	569,687
In the military	322,210	64,733	20.1	68,486
In jail or prison	46,478	2,906	6.3	3,474
In a nursing home	47,034	23,474	49.9	24,884
Person multiple	107,748	20,330	18.9	25,248
Household multiple	334,859	120,211	35.9	171,627
Administrative Records	391,637	15,738	4.0	19,766
Unduplicated Total	**4,536,636**	**1,006,664**	**22.2**	**1,235,096**

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

Just as a roster member could be added only at certain places in the interview, a roster member could also be deleted only at certain places in the interview. Table 53 shows the number of persons deleted at each of these points. The college probe deleted 53.2 percent of the deleted persons; this result pairs well with Table 52's view of case types with deleted persons.

Table 53: Number of People Deleted by Roster Review and "Living Situation" Probe

Roster Review or Living Situation Probe*	Number of Deleted Persons	Percent of Deleted Persons**
Roster review	157,523	12.8
Unknown person	128,426	10.4
Duplicated person	29,097	2.4
Moved	37,211	3.0
College	656,817	53.2
Child custody	94,827	7.7
Military	74,160	6.0
Job	38,012	3.1
Seasonal or second home	102,693	8.3
Other address	81,856	6.6
Group quarters	37,104	3.0
Born After Census Day	1,272	0.1
Unduplicated Total	**1,235,096**	

Source: CFU Analysis File and Aux

* Probe categories are not mutually exclusive.

**Because the probe categories are not mutually exclusive, the number of deleted persons and the percent of deleted persons do not sum to 100 percent.

Table 54 shows the distribution of households with deleted persons by interview language. While the average percent of completes was 22.2, only cases completed in Korean had a higher delete rate than those completed in English.

Table 54: Households with a Deleted Person by Interview Language

Interview Language	Number of Cases Completed in CFU	Number of Cases with a Deleted Person	Percent of Completed Cases	Number of Deleted Persons
English	4,103,862	956,462	23.3	1,170,283
Spanish	393,266	43,861	11.2	56,858
Chinese	16,502	2,859	17.3	3,563
Korean	4,983	1,298	26.0	1,568
Russian	3,546	354	10.0	456
Vietnamese	9,853	1,169	11.9	1,536
Other	1,342	277	20.6	342
Missing	3,282	384	11.7	490
Total	**4,536,636**	**1,006,664**	**22.2**	**1,235,096**

Source: CFU Analysis File

Table 55 shows the distribution of households with deleted persons by form type. As in Table 33 and Table 43, the enumerator forms were more likely to produce a deleted person than the respondent forms.

Table 55: Households with a Deleted Person by Form Type

Form Type	Number of Cases Completed in CFU	Number of Cases with a Deleted Person	Percent of Completed Cases	Number of Deleted Persons
Respondent-Provided	4,153,785	912,758	22.0	1,123,754
MO/MB -- English	3,612,845	830,134	23.0	1,016,826
MO/MB -- Bilingual	491,421	76,108	15.5	98,829
MO/MB -- Fulfillment	10,173	704	6.9	916
U/L -- English Stateside	294	54	18.4	75
U/L -- Puerto Rico	39,052	5,758	14.7	7,108
Enumerator-Provided	382,851	93,906	24.5	111,342
TQA	635	119	18.7	139
NRFU	370,641	90,511	24.4	107,227
U/E	11,575	3,276	28.3	3,976
Total	**4,536,636**	**1,006,664**	**22.2**	**1,235,096**

Source: CFU Analysis File

5.5.3.2 Deleted Roster Members by Demographic Variables[34]

There were 986,181 households with a deleted data-defined person for a total of 1,203,914 deleted data-defined persons included on 4,536,636 CFU forms in the 2010 Census. All non-data-defined persons were deleted from the household roster during residence coding. Non-data-defined deleted roster members are not included in any demographic tables, but they are included in non-demographic tables. Thus, the number of deleted persons in the demographic tables is less than the number of deleted roster members in the non-demographic tables.

Table 56 shows the age of deleted roster members. The age brackets of 15 through 19 and 20 through 24 contain 25.0 percent and 36.6 percent of the deleted roster members respectively. Since Table 52 showed that the source of coverage improvement with the most deleted persons was the overcount category "in college housing", this age concentration makes sense.

---

[34] All tables in this section contain frequencies on unimputed and unedited demographic data.

Table 56: Deleted People by Age

Age in Years	Number of Deleted People	Percent of Deleted Persons
Under 5 years	27,472	2.3
5 to 9 years	35,338	2.9
10 to 14 years	44,283	3.7
15 to 19 years	300,912	25.0
20 to 24 years	440,282	36.6
25 to 29 years	50,160	4.2
30 to 34 years	28,012	2.3
35 to 39 years	25,053	2.1
40 to 44 years	24,326	2.0
45 to 49 years	26,559	2.2
50 to 54 years	28,335	2.4
55 to 59 years	26,882	2.2
60 to 64 years	25,577	2.1
65+ years	93,558	7.8
Missing	27,165	2.3
Total	**1,203,914**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 57 shows the selected Hispanic origin of deleted roster members. With 83.7 percent of deleted roster members, the "Not Hispanic or Latino" checkbox was selected most often.

Table 57: Deleted People by Hispanic Origin

Hispanic Origin	Number of Deleted Persons	Percent of Deleted Persons
Not Hispanic or Latino checkbox only	1,007,914	83.7
Mexican checkbox only	58,870	4.9
Puerto Rican checkbox only	20,889	1.7
Cuban checkbox only	5,075	0.4
Another Hispanic checkbox only	3,481	0.3
Multiple checkboxes	2,589	0.2
Both Checkbox and Write-in	40,654	3.4
Write-in Only	11,211	0.9
Missing	53,231	4.4
Total	**1,203,914**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 58 shows the selected race of deleted roster members. With 69.4 percent of deleted roster members, persons with only the "White" checkbox alone were deleted most often.

Table 58: Deleted People by Race

Race	Number of Deleted People	Percent of Deleted Persons
White checkbox alone	835,977	69.4
Black or African American checkbox alone	141,480	11.8
American Indian and Alaska Native checkbox alone	1,748	0.1
Asian Indian checkbox alone	13,896	1.2
Chinese checkbox alone	18,186	1.5
Filipino checkbox alone	9,353	0.8
Japanese checkbox alone	1,971	0.2
Korean checkbox alone	7,529	0.6
Vietnamese checkbox alone	5,213	0.4
Other Asian checkbox alone	305	0.0
Native Hawaiian checkbox alone	449	0.0
Guamanian or Chamorro checkbox alone	244	0.0
Samoan checkbox alone	281	0.0
Other Pacific Islander checkbox alone	57	0.0
Some Other Race checkbox alone	768	0.1
Multiple checkboxes	20,852	1.7
Both Checkbox and Write-in	84,545	7.0
Write-in Only	14,834	1.2
Missing	46,226	3.8
Total	**1,203,914**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 59 shows the selected relationship status of deleted roster members to the householder. With 61.2 percent of deleted roster members, persons with only the "Biological Son or Daughter" checkbox selected were deleted most often.

Table 59: Deleted People by Relationship*

Relationship	Number of Deleted People	Percent of Deleted Persons
Householder	126,778	10.5
Husband/Wife of Householder	80,598	6.7
Biological Son or Daughter of Householder	736,285	61.2
Adopted Son or Daughter of Householder	16,725	1.4
Stepson or Stepdaughter of Householder	42,349	3.5
Brother or Sister of Householder	13,858	1.2
Father or Mother of Householder	15,780	1.3
Grandchild of Householder	35,805	3.0
Parent-in-law of Householder	4,705	0.4
Son-in-law or Daughter-in-law of Householder	5,190	0.4
Other Relative	19,836	1.6
Related**	13,975	1.2
Roomer or Boarder	6,012	0.5
Housemate or Roommate	10,110	0.8
Unmarried Partner	12,806	1.1
Other Nonrelative	24,271	2.0
Not Related**	4,536	0.4
Two or more relationships	2,176	0.2
Missing	32,119	2.7
Total	**1,203,914**	**100.0***

Source: CFU Analysis File

*The definition of the relationship categories differs slightly from the definitions for the standard demographic tables. Since responses to the Related and Not Related question on the returns sent to CFU persisted in the returns from CFU, a person was given a relationship category first by ignoring these two responses and then including them if no other relationship response was given in CFU. The standard demographic definition is used in Appendix C: Standard Demographic Tables, so care should be taken when comparing relationship tables in this report.
**This relationship category is not found on CFU or TQA returns
*** Percentages do not sum to 100 percent due to rounding

Table 60 shows the selected sex of deleted roster members. Slightly more deleted roster members had selected only the "Male" checkbox than those who had selected only the "Female" checkbox, which is similar to the results of the 2005 National Census Test (Sheppard et al., 2007).

Table 60: Deleted People by Sex

Sex	Number of Deleted Persons	Percent of Deleted Persons
Male	615,643	51.1
Female	568,649	47.2
Both	1,584	0.1
Missing	18,038	1.5
Total	**1,203,914**	**100.0***

Source: CFU Analysis File

* Percentages do not sum to 100 percent due to rounding

Table 61 shows the selected tenure of households with a deleted roster member. With 63.3 percent, more households with deleted roster members selected only the "Owned with a mortgage or a loan" checkbox.

Table 61: Households with Deleted People by Tenure

Tenure	Number of Cases with a Deleted Person	Percent of Cases with Deleted People
Owned with a mortgage or a loan	624,414	63.3
Owned without a mortgage or a loan	159,086	16.1
Rented	184,194	18.7
Occupied without payment of rent	13,315	1.4
Multiple	3,862	0.4
Missing	1,310	0.1
Total	**986,181**	**100.0**

Source: CFU Analysis File

5.5.4   Item Non-Response Rates[35]

In addition to identifying missing household members, cases with a source of coverage improvement of LHH were sent to CFU to collect demographic information for persons on the extended rosters. Additionally, the CFU interview attempted to obtain complete demographic data for all roster members from all case types. Table 62 shows the non-response rates for each demographic item on the original form and in the CFU interview. A non-response includes responses of "Don't know" or "Refuse" as well as interviews that ended before demographic items were collected in CFU. Hispanic Origin and Race were the two items with the highest item non-response from the original form at 5.6 percent and 6.0 percent respectively. The item non-response rate drops to 0.6 percent and 1.0 percent for those two items after the CFU interview, making Hispanic Origin and Race the two items with the largest percentage point decrease. Added roster members are not included in Table 62.

---

[35] These item non-response rates are not final and do not reflect any imputation or edits made after the CFU interview.

Table 62: Demographic Item Non-Response Rate for Existing Roster Members

Demographic Item	Original Form	CFU Interview	Percentage Point Decrease
Age	3.5	0.8	2.8*
Date of Birth	2.2	0.9	1.3
Sex	2.5	0.1	2.5*
Relationship**	1.7	0.2	1.5
Hispanic Origin	5.6***	0.6	5.0^
Race	6.0***	1.0	5.0^

Source: CFU Analysis File

* Due to rounding, percentage points may not sum to the exact numbers in the table

** Person 1 is not included in the relationship item non-response rate

*** Roster members from the extended roster portion of the Mailout/Mailback and Experimental forms are not included in the Hispanic Origin and Race categories because those items were not asked for extended roster members due to space constraints.

^Since the universe of the original form item non-response differs from the universe of the CFU item non-response, exercise caution when referring to this decrease.

Also of interest is the completeness of the demographic information for roster members added during CFU. Table 63 shows how often each demographic item was not answered in CFU. The date of birth item was not answered for 24.4 percent of added roster members. The high non-response rate for date of birth could be a result of respondents' hesitation to provide such specific and non-observable information about potentially non-related roster members.

Table 63: Demographic Item Non-response Rate for Added Roster Members

Demographic Item	Item Non-Response Rate
Age	5.6
Date of Birth	24.4
Sex	1.2
Relationship	4.5
Hispanic Origin	4.2
Race	5.6

Source: CFU Analysis File

5.5.5 CFU Cases by Unique Source of Coverage Improvement

Throughout this assessment, tables that show results by source of coverage improvement count cases with multiple sources of coverage improvement multiple times. The following tables group the cases into mutually exclusive categories so that the effects of certain case types can be observed. Cases that include any non-production source of coverage improvement in addition to a production source of coverage improvement are not included in these tables, so total numbers may differ from other tables in this assessment. Analysis on production and non-production overlapping cases can be found in the Alternative Coverage Followup Questions and Design Evaluation.

5.5.5.1 Interview Results by Unique Source of Coverage Improvement

By looking at the households with added or deleted persons by unique source of coverage improvement, both drivers and important relationships emerge. Table 64 shows the number of households with added or deleted roster members. The percent of "in college housing" cases with a roster change was 73.6 percent, a slight decrease from the 74.9 percent seen in Table 29 when the sources of coverage improvement are unduplicated.

Table 64: Households with Added or Deleted People by Unique Source of Coverage Improvement

Source of Coverage Improvement	Number of Cases Completed in CFU	Number of Cases with Added or Deleted People	Percent of Completed Cases	Number of Added or Deleted People
Large Households Only	587,917	29,847	5.1	48,374
Count Discrepancies Only	478,472	122,848	25.7	173,220
High only	311,280	58,523	18.8	77,402
Low only	167,192	64,325	38.5	95,818
Undercount Only	814,659	104,915	12.9	135,266
Children only	135,529	16,468	12.2	21,941
Relatives only	343,179	40,525	11.8	52,430
Nonrelatives only	100,395	13,703	13.6	17,179
People staying temporarily only	235,556	34,219	14.5	43,716
Overcount Only	1,273,203	593,190	46.6	694,945
In college housing only	567,970	418,063	73.6	476,368
In the military only	296,332	55,984	18.9	60,237
In jail or prison only	34,111	2,504	7.3	3,134
In a nursing home only	35,864	16,264	45.3	17,473
Person multiple only	88,767	15,596	17.6	19,187
Household multiple only	250,159	84,779	33.9	118,546
Administrative Records Only[36]	298,547	11,676	3.9	17,986
Multiple Sources	468,698	194,750	41.6	272,263
Total	**3,921,496**	**1,057,226**	**27.0**	**1,342,054**

Source: CFU Analysis File

Table 65 shows the households with added persons by unique source of coverage improvement. Case types that had high add rates in the unduplicated table show even higher rates in this table. Cases with a coverage improvement source of only low count discrepancy added a roster member in 36.6 percent of cases, while Table 40 showed that 31.2 percent of cases that had low count discrepancy as one of a case's source of coverage improvement saw an addition to the household roster. All of the undercount categories show gains as well, while the LHH and overcount categories show a decrease in the percent of households with added persons when going from overlapping sources of coverage improvement to unique source of coverage improvement. This trend suggests that a source of coverage improvement of low count discrepancy or any of the undercount categories alone indicates a high probability that someone is missing from the roster; any additional sources could indicate a different issue. These add rates are similar to what happened in the 2005 National Census Test (Sheppard et al., 2007) and are expected because the undercount categories and low count discrepancy cases are sources of coverage improvement associated with missing persons. The add rate for LHH is lower than what was seen in the 2005 National Census Test (Sheppard et al., 2007). Additional analysis may provide more explanation for the lower LHH rate.

---

[36] See 5.5.1.1 for discussion about AR cases.

Table 65: Households with an Added Person by Unique Source of Coverage Improvement

Source of Coverage Improvement	Number of Cases with an Added Person	Percent of Completed Cases	Number of Added Persons
Large Households Only	13,613	2.3	19,272
Count Discrepancies Only	69,167	14.5	101,380
High only	7,956	2.6	10,621
Low only	61,211	36.6	90,759
Undercount Only	70,005	8.6	89,604
Children only	12,132	9.0	16,106
Relatives only	21,149	6.2	27,351
Nonrelatives only	7,947	7.9	9,788
People staying temporarily only	28,777	12.2	36,359
Overcount Only	15,849	1.2	19,725
In college housing only	5,980	1.1	7,385
In the military only	3,063	1.0	3,814
In jail or prison only	1,014	3.0	1,303
In a nursing home only	574	1.6	716
Person multiple only	1,227	1.4	1,560
Household multiple only	3,991	1.6	4,947
Administrative Records Only[37]	8,310	2.8	13,290
Multiple Sources	36,117	7.7	61,014
Total	**213,061**	**5.4**	**304,285**

Source: CFU Analysis File

Table 66 shows the households with a deleted person by unique source of coverage improvement. Of households with only "in college housing" as the source of coverage improvement, 73.3 percent deleted a roster member, which is down from 74.5 percent of households with "in college housing" as one of the sources of coverage improvement. In fact, all other sources of coverage improvement, including other overcount categories as well as high count discrepancy cases, also see a slight decrease in the percent of households with deleted roster members. This difference could mean that cases with more sources of coverage improvement are more likely to have complicated living situations and potentially incorrectly enumerated roster members.

---

[37] See 5.5.1.1 for discussion about AR cases.

Table 66: Households with a Deleted Person by Unique Source of Coverage Improvement

Source of Coverage Improvement	Number of Cases with a Deleted Person	Percent of Completed Cases	Number of Deleted Persons
Large Households Only	17,586	3.0	29,102
Count Discrepancies Only	56,159	11.7	71,840
High only	52,066	16.7	66,781
Low only	4,093	2.4	5,059
Undercount Only	37,258	4.6	45,662
Children only	4,718	3.5	5,835
Relatives only	20,392	5.9	25,079
Nonrelatives only	6,104	6.1	7,391
People staying temporarily only	6,044	2.6	7,357
Overcount Only	584,146	45.9	675,220
In college housing only	416,113	73.3	468,983
In the military only	53,739	18.1	56,423
In jail or prison only	1,598	4.7	1,831
In a nursing home only	15,965	44.5	16,757
Person multiple only	14,563	16.4	17,627
Household multiple only	82,168	32.8	113,599
Administrative Records Only	3,850	1.3	4,696
Multiple Sources	164,574	35.1	211,249
Total	**863,573**	**22.0**	**1,037,769**

Source: CFU Analysis File

5.5.5.2 Interview Results by Multiple Sources of Coverage Improvement

Since 12 percent of completed cases had multiple sources of coverage improvement, it is worth looking at their attributes. In this section, the following shorthand will be used:

- LHH: Large Household
- CDH: Count Discrepancy – High
- CDL: Count Discrepancy – Low
- UCC: Undercount – Children
- UCR: Undercount – Relatives
- UCN: Undercount – Nonrelatives
- UCT: Undercount – Temporary
- OCC: Overcount – College
- OCM: Overcount – Military
- OCJ: Overcount – Jail or prison
- OCN: Overcount – Nursing home
- OCPM: Overcount – Person multiple
- OCHM: Overcount – Household multiple
- AR: Administrative Records

Table 67 shows the most frequent combinations of sources of coverage improvement. These ten combinations account for 47.4 percent of all cases with multiple sources of coverage improvement. All ten of these combinations include either LHH or high count discrepancy as a reason of coverage improvement. Almost all of these combinations saw over ten percent of their completed cases with an added or deleted person.

Table 67: Top Ten Most Frequent Sources of Coverage Improvement Combinations

Source of Coverage Improvement*	Number of Cases Completed in CFU	Percent of Cases with Added or Deleted People	Percent of Cases with Added People	Percent of Cases with Deleted People
LHH/CDL	43,429	24.1	20.6	4.3
CDH/OCC	42,496	90.7	0.8	90.6
LHH/CDH	26,189	22.2	4.1	19.1
LHH/AR	19,296	7.8	4.6	3.6
CDH/UCR	18,093	16.3	3.9	13.2
CDH/OCHM	17,558	65.1	2.2	64.0
CDH/UCT	14,670	15.4	4.7	11.3
CDH/UCR/OCC	14,095	90.4	1.1	90.3
LHH/OCC	13,610	72.0	2.2	71.3
LHH/OCHM	12,855	38.1	3.3	36.0

Source: CFU Analysis File
*LHH=Large Household, CDL=Count Discrepancy – Low, CDH=Count Discrepancy – High, OCC=Overcount – College, OCHM=Overcount – Household Multiple, UCR=Undercount – Relative, UCT=Undercount – Temporary, AR=Administrative Records

Table 68 shows the twenty case type combinations with the highest percent of households with added or deleted people and at least 100 completed cases. Also of note is that all twenty of these case types saw more deleted roster members than added roster members. This makes sense because each of these case types includes an overcount source of coverage improvement, and overcount cases had high delete rates. Sixteen of these twenty case types include "in college housing" as a source of coverage improvement, which was shown in Table 64 to have an add or delete rate of 73.6 percent when the only source of coverage improvement. In addition, twelve of these twenty case types include high count discrepancy. Interestingly, the add or delete rate of high count discrepancy alone is 18.8 percent. While the rate of high count discrepancy alone is higher than some other categories, it is not as high as the overcount category "in a nursing home" only, for example. So, cases with a source of coverage improvement of high count discrepancy alone is not a particularly strong indicator that the case will have roster changes, but a source of coverage improvement of high count discrepancy with at least one other reason indicates that the case will likely see a roster change. This observation is particularly noticeable in the case of the 7,759 cases with both high count discrepancy and the overcount category "in the military" as a source of coverage improvement. Both categories alone have an add or delete rate of 18.8 percent and 18.9 percent respectively, but cases with both show an add or delete rate of 65.8 percent.

Table 68: Sources of Coverage Improvement Combinations with the Highest Add or Delete Rates

Source of Coverage Improvement*	Number of Cases Completed in CFU	Percent of Cases with Added or Deleted People	Percent of Cases with Added People	Percent of Cases with Deleted People
CDH/UCC/OCC	2,376	91.5	1.1	91.3
CDH/OCC	42,496	90.7	0.8	90.6
CDH/UCR/OCC	14,095	90.4	1.1	90.3
CDH/AR/OCC	318	85.8	3.8	85.8
LHH/CDH/UCR/OCC	272	82.4	3.3	82.0
CDH/UCT/OCC	3,026	81.8	2.1	81.3
LHH/CDL/OCC	1,074	81.3	13.5	76.4
LHH/CDH/OCC	1,062	81.3	3.0	80.7
CDH/OCN	7,680	77.4	1.0	77.1
LHH/UCT/OCC	176	74.4	13.6	70.5
LHH/CDH/UCT/OCC	121	74.4	7.4	72.7
UCC/OCC	2,305	73.4	6.0	71.5
AR/OCC	4,856	72.8	2.9	72.2
UCR/OCC	8,922	72.3	4.8	71.1
LHH/OCC	13,610	72.0	2.2	71.3
LHH/UCR/OCC	375	70.4	8.0	67.2
CDL/UCR/OCC	126	68.3	20.6	64.3
CDH/OCR/OCM	1,290	68.0	2.3	67.2
CDH/UCC/OCHM	2,121	66.4	4.4	64.2
CDH/OCM	7,759	65.8	1.3	65.2

Source: CFU Analysis File
*LHH=Large Household, CDL=Count Discrepancy – Low, CDH=Count Discrepancy – High, OCC=Overcount – College, OCM=Overcount – Military, OCN=Overcount – Nursing, OCHM=Overcount – Household Multiple, UCC=Undercount – Child, UCR=Undercount – Relative, UCT=Undercount – Temporary, AR=Administrative Records

Table 69 shows the ten case type combinations with the highest percent of households with added people and at least 100 completed cases. This table shows only ten case types because the percent of households with deleted people begins to be greater than the percent of households with added people. All ten case types include low count discrepancy, which was the source of coverage improvement with the highest add rate in Table 40 and Table 65. The case type with the highest percent of added people is low count discrepancy and AR. The add rate is higher than low count discrepancy or AR alone, which suggests that self-identification paired with the use of administrative records is an effective practice.

Table 69: Sources of Coverage Improvement Combinations with the Highest Add Rates

Source of Coverage Improvement*	Number of Cases Completed in CFU	Percent of Cases with Added or Deleted People	Percent of Cases with Added People	Percent of Cases with Deleted People
CDL/AR	3,268	43.7	42.0	2.4
LHH/CDL/AR/UCR	137	42.3	40.9	2.2
LHH/CDL/AR	2,458	42.2	40.5	3.7
CDL/AR/UCR	177	38.4	35.0	5.1
CDL/OCJ	192	40.1	34.9	7.3
LHH/CDL/UCC	1,002	37.7	32.7	6.4
CDL/OCM	661	43.3	31.9	17.4
CDL/OCPM	340	42.6	30.9	14.1
CDL/UCC	4,050	37.5	29.7	9.1
CDL/OCN	129	48.8	28.7	29.5

Source: CFU Analysis File

*LHH=Large Household, CDL=Count Discrepancy – Low, OCM=Overcount – Military, OCN=Overcount – Nursing, OCJ=Overcount – Jail, OCHM=Overcount – Household Multiple, OCPM=Overcount – Person Multiple, UCC=Undercount – Child, UCR=Undercount – Relative, AR=Administrative Records

The ten case type combinations with the highest percent of households with deleted people and at least 100 completed cases can all be found in Table 68. For the complete table, see Appendix D.

5.6 Quality Programs

CFU included two operations that assessed quality. The Service Quality Assurance (SQA) operation measured interviewer performance, and the Data Quality (DQ) operation measured the accuracy of the data collected. Both operations drew interviews to review from a pool of calls randomly recorded by the eyeQ360 application.

5.6.1 Service Quality Assurance Program

SQA fulfilled a CFU requirement that each interviewer be monitored at least twice a day 95 percent of the time. Using eyeQ360 recordings, SQA monitors scored interviewers' performance by observing how well the interviewer correctly captured respondents' responses and how well the interviewer used customer service soft skills. SQA scores were calculated by dividing the number of earned points by the number of possible points. Interviewers that failed a call received coaching. Scores were monitored at an operational level, and refresher training and job aids were released to improve scores.

The final overall score for 2010 CFU was 99.0 percent. Table 70 shows the SQA score by call center. The range of average SQA scores is within one percentage point; both Denver and Stockton had the highest average SQA score of 99.3 percent, and Kennesaw had the lowest

average SQA score of 98.6 percent. The small range of scores could be attributed to weekly calibration sessions that the SQA managers of each call center had with a central SQA team and Census Bureau representatives. These calibration sessions ensured that scoring standards were consistent across the call centers.

Table 70: Average Service Quality Assurance Score by Call Center

Call Center	Average SQA Score (in Percent)	Number of Calls Scored in CFU
Denver, Colorado	99.3	27,940
Kennesaw, Georgia	98.6	93,734
Lawrence, Kansas	99.0	21,563
London, Kentucky	98.8	77,968
Monticello, Kentucky	99.2	40,974
Murray, Utah	99.1	82,904
Ogden, Utah	99.2	36,340
Phoenix, Arizona	98.9	26,175
Sandy, UT (ACS)	98.7	15,406
Sandy, UT (Vangent)	99.0	90,528
Stockton, California	99.3	46,107
Overall	**99.0**	**559,639**

Source: SQA Metrics

Each of the first seven critical criteria was scored only if that module was entered during that call, while the eighth critical criterion was scored in every call. Table 71 shows the SQA scores of the eight critical criteria. The average SQA score of each criterion can be interpreted as the percent of monitored cases that did not fail that criterion. The seven module-specific criteria have similar scores, but the "Read scripts verbatim" criterion has a lower score than the others. This corresponds to observations made during the operation that noted some interviewers' tendency to amend or abridge the given script.

Table 71: Average Service Quality Assurance Score by Critical Criteria

Critical Criteria	Average SQA Score (in Percent)	Percent of Monitored Cases With a Failure
Module A capture	99.0	1.0
Module B capture	99.9	0.1
Module C capture	99.8	0.2
Module D capture	99.6	0.4
Module E capture	99.9	0.1
Module F capture	99.2	0.8
Module G capture	99.7	0.3
Read scripts verbatim	95.4	4.6

Source: SQA Metrics

In addition to the eight critical criteria, interviewers were scored on seven universal criteria that addressed an interviewer's soft skills, such as call control. Universal criteria were always scored in every call, and an interviewer could earn a score of "Meets Standard", "Needs Improvement",

or "Needs Significant Improvement" on each. While the critical criteria could usually be scored easily since they evaluated if an interviewer correctly captured the living situation of the household, the universal criteria required more perception to score accurately. Table 72 shows the SQA scores of each universal criterion as well as the percent of scored cases that received a "Needs Improvement" or a "Needs Significant Improvement" score. The SQA score is the number of achieved points over the number of potential points; since all of these items were scored in every call, this column shows the percentage of cases that had a perfect score in each of the universal criteria. All of the universal criteria had a score of over 96.9 percent. A slightly higher percentage of cases were scored as "Needs Significant Improvement" in the universal criterion "Effectively and efficiently navigate systems" than in other criteria.

Table 72: Average Service Quality Assurance Score by Universal Criteria

Universal Criteria	Average SQA Score (in Percent)	Percent of Monitored Cases with a Needs Improvement Score	Percent of Monitored Cases with a Needs Significant Improvement Score
Display courtesy and professionalism	97.5	2.8	0.8
Display enthusiasm and confidence	98.3	2.1	0.5
Provide accurate and complete information	98.1	2.1	0.7
Effectively control the call	97.1	3.4	0.9
Effectively use active listening and probing questions	97.3	2.9	0.9
Effectively and efficiently navigate systems	96.9	2.2	1.8
Appropriately document and disposition the call	97.9	2.3	0.8

Source: SQA Metrics

Each call also was given a Code of Conduct score. A call would receive a Code of Conduct failure for serious customer service infractions such as intentionally disconnecting a call or using profanity. Any Code of Conduct failure resulted in a call with a score of zero. Out of the 559,639 calls scored in SQA, 156 calls had a Code of Conduct failure.

5.6.2 Data Quality Assurance Program

In the DQ operation, a small group of monitors evaluated the accuracy of the data collected based on a small daily sample of calls where the case was closed within that call. Monitors scored a total of fifteen questions from two modules as "Accurate," "Inaccurate," "Uncertain," or "Not Scored." If a critical question was scored as "Inaccurate" or "Uncertain," the monitor was required to give a reason for the score from a list of reason codes. An "Inaccurate" score might be given for an interviewer not reading a question at all, an interviewer selecting the incorrect answer option, or the system recording a response that was not what the interviewer selected. An

"Uncertain" score may have been given for a complicated exchange between the interviewer and the respondent or for an interviewer not reading a question verbatim. The scores were never reported back to the interviewers; DQ was used to monitor the accuracy of the data and to support trends observed in SQA.

The DQ score, called the Quality Improvement Index (QII), was calculated by dividing the number of critical questions with accurate scores by the number of critical questions with accurate or inaccurate scores. The overall QII was 0.994. Appendix E: Quality Improvement Index by Call Center shows the QII scores by call center and over time. In this table, the time periods are based on each call center's start date, not on the operational start date. Scores were very high overall, and nearly every call center shows improvement over time. Monticello is the only call center with scores that show any downward movement, but the change is not large. The call centers have similar overall QII scores, which was expected because the same group of monitors scored all of the recordings across all call centers.

Table 73 looks at the QII by critical question. Not all questions were asked in every interview, and the QII for a question includes only the cases where that question was scored as "Accurate" or "Inaccurate." Most question scores were over 0.96, but the QII of the question asking for the name of the unrecognized roster member is below 0.90. This is likely due to interviews where the interviewer had to loop through Module D to delete duplicated or unknown persons. Interviewers sometimes had difficulty dropping duplicated persons, and they would sometimes not re-read required scripted text, which would affect QII scores.

Table 73: Average QII Score by Critical Question

Critical Question	Average QII	Frequency Scored
Any unrecognized roster members	0.996	10,011
Name of unrecognized roster member	0.874	323
Respondent's name is correct	0.980	1,588
Missing babies	0.999	11,501
Missing relatives	0.998	11,452
Missing people who stayed often	0.998	11,447
Anyone in college	0.998	5,865
Name of college student	0.981	2,476
College address	0.994	2,962
Anyone stay at another address	0.998	11,511
Name of person staying at other address	0.963	408
Lived at which address most of the time	0.991	4,274
Staying where on Census Day	1.000	76
Anyone stay in a group quarters	0.993	35,675
Age of added person on Census Day	0.980	965

Source: DQ Metrics

5.7   Costs

The cost results presented in this assessment were generated by program office staff using methods predating the US Census Bureau's commitment to comply with Government Accountability Office's cost estimating guidelines and the Society of Cost Estimating and Analysis best practices. Hence, while the Census Bureau believes these cost results are accurate and will meet the needs for which they will be used, the methods used for estimating costs of 2010 Census operations may not meet all of these guidelines and best practices. The Census Bureau will adhere to these guidelines in producing 2020 Census cost estimates.

5.7.1   Total Cost[38]

The CFU operation was included as part of the DRIS contract for the 2010 Census. The estimated total cost of conducting CFU was $353,788,000; this total combines the costs of Project Management, Engineering, Architecture, Testing, Data Quality, Security, Operation Management, Telecommunications, and Fingerprinting. These costs were shared across several operations within the DRIS contract. Due to the shared costs, the precise total cost of CFU cannot be extrapolated. For example, five of the eleven CFU telephone call centers had previously been used by the TQA operation, which was also incorporated within the DRIS contract. The infrastructure costs associated with these call centers were shared across the CFU and TQA operations.

For the purposes of coverage improvement cost analysis, the operations cost of CFU was used to identify the cost of working the CFU workload. The operations cost of CFU was an estimated $202,161,000, which included all labor and infrastructure costs associated with the CFU operation. Labor costs contained charges for interviewers, lead interviewers, supervisors, and management during testing and production. Infrastructure costs consisted of charges for work force management, call monitoring, per call charges, and the dialer solution.

Table 74 illustrates all cost categories were under budget.

Table 74: Estimate at Complete Costs and Budgeted Costs

Cost Category	Estimate at Complete	Budget at Complete	Percent Under Budget at Complete
Total CFU Costs	$353,788,000	$369,720,000	4.3
CFU Operations	$202,161,000	$212,789,000	5.0
Non-Operational Costs[39]	$151,627,000	$156,931,000	3.4

Source: July 2011 CPR

---

[38] Cost numbers include only contractor-related costs and thus do not account for costs incurred by HQP and other Census Bureau activities.
[39] The non-operational costs include Project Management, Engineering, Testing, Data Quality, Security, Telecommunications, and Fingerprinting

5.7.2 Operational Cost per Attempted Case

The operational cost per attempted case was derived from dividing the operations cost of CFU, $202,161,000, by the number of CFU attempted cases (which was the total number of cases in the dialer), 7,372,078, which calculated to $27.42 per case. This calculation assumed equal cost for each case attempted; both production and "Other Sources" cases were attempted.

5.7.3 Operational Cost per Case with at Least One Roster Change

As a result of the CFU operation, there were 1,262,146[40] household roster changes. These household roster changes were operation-based, not census-based. Dividing the operations cost of CFU, $202,161,000, by the number of CFU cases with at least one roster change, 1,262,146, the cost per roster change was an estimated $160.17.

5.8 Implementation Lessons Learned

Overall, the implementation of CFU was quite successful. All operational aspects worked together to produce a quality product. This section highlights some particularly successful implementation practices and identifies some areas for improvement.

These lessons learned were compiled from Decennial Management Division (DMD) lessons learned, DRIS lessons learned, Program Management Office (PMO) lessons learned, WCM lessons learned, observation reports, and a call center staff survey.

5.8.1 Requirements

DRIS lessons learned showed that the requirements were created successfully and, while some restructuring of the requirements caused some confusion, the requirements were well integrated.

Census Bureau lessons learned revealed that DMD requirements were drafted after the contract was awarded. The recommendation was given that high-level requirements should be drafted by the Census Bureau before detailed requirements are created by the contractor.

5.8.2 Testing

Multiple phases of testing were conducted by DRIS between the 2008 Dress Rehearsal and the beginning of the 2010 CFU operation. Segment testing, System Integration Testing (SIT), External Interface (EI) testing and two of the three Operational Test and Dry Runs (OTDR) were all conducted with the CFU instrument. All phases of testing resulted in improved understanding of the systems in use for CFU, identification of issues and risks, and correction of problems.

---

[40] This number includes roster changes from all cases sent to CFU, including cases with only non-production sources of coverage improvement. This number will differ from all other numbers presented in this report so far.

End-to-end testing of the system at a case level instead of at a batch level was a novel and beneficial practice in 2010 CFU.

Collaboration in developing and reviewing segment test scripts between the Census Bureau and DRIS boosted confidence in all test phases. This was conducive to a better understanding of later, more integrated tests.

The EI tests were used to both verify that file transfers between DRIS and the Census Bureau were successful and to verify that content entered into the application was accurately captured in the database. This test proved to be very useful for identifying issues with the application and data file structure. However, extensive EI testing was not originally in scope to the extent desired, so the focus of the test was not prioritized or clearly defined. This caused a lack of scheduled time to conduct the tests and necessitated a high level of Census Bureau and DRIS development team involvement in the tests.

While multiple tests were conducted on CFU, there was an unfulfilled need to test and prepare more thoroughly for potential anomalies in the data by using non-standard test data. For example, name fields that said "error" or "n/a" were not tested, and the appearance of such nonsense words in the name fields during operations found the CFU team unprepared. Additionally, the lack of exception testing led to the discovery of unorthodox operational scenarios and the development of mitigating procedures during operations.

A Usability Test was conducted with experienced telephone interviewers[41] by the Census Bureau prior to the 2008 Dress Rehearsal (Murphy, 2007). It would have been valuable to have Usability Testing or Operational Testing Support of the application during the design phase to impact the design of the system from an operations perspective. For example, observations during production found that many interviewers used the "Call Disconnected-Disconnected" disposition as a default disposition because it was easy to select and use; this interviewer habit may have resulted in the closure of some cases that should not have been closed. A better understanding of how interviewers use the application could have led to application improvements or to training suggestions.

5.8.3 Dialer Lessons Learned

One requirement of the automated dialer was that it would not use predictive dialing. The DRIS contractor assessed this decision as follows: "[…] non-predictive, one-to-one dialing required more staff per dial attempt and limited efficiencies. The inability of the interviewers to easily log in and out of the "reserved"[42] state was a function of the CFU dialer migrating away from

---

[41] These interviewers were selected from the Hagerstown Telephone Center in Hagerstown, Maryland. Interviewers had previous interviewing experience, but not necessarily previous CFU-specific experience.

[42] Interviewers were 'reserved' while the dialer was dialing. Interviewers could not log out or go to break during this time; they had to wait until they got a call and then change their status during that call. This sometimes led to lengthy periods of time where an interviewer could not change their status and therefore got "stuck." This issue also led to scheduling issues (i.e. interviewers were not able to go to lunch or take breaks as scheduled).

progressive dialers." DRIS suggested that tuning the predictive technology to be more similar to standard progressive dialing would have reduced this effect.

While the skill strategy allowed the dialer to identify qualified interviewers for a particular call, the skill strategy was not designed to dynamically associate an interviewer with multiple skills. An inbound-outbound multi-skilled interviewer would have helped to resolve issues experienced with re-skilling agents between the two call directions.

The Census Bureau required DRIS to allow for a refusal conversion skill type. The purpose of this skill type was to give interviewers with excellent soft skills cases where the respondent had previously refused to complete the interview. Ultimately, a design decision was made to process English refusal cases via the Spanish dialing queue. This was not the most effective method in handling refusal calls. Due to multiple iterations of skilling design, there was insufficient time to review and accept the process for handling refusals. By the time the review occurred, technical changes could not be implemented due to time constraints in solution development. Due to higher than forecasted volumes of English refusals and Spanish cases, interviewers were unable to adequately work through the workload of Spanish cases, which resulted in multiple technical modifications to ensure that all cases were dialed. The DRIS team also recommended that the handling of English refusal cases be altered in future operations. Having the English refusal cases – in addition to the Spanish refusal cases – put an additional strain on these interviewers.

5.8.4 Capacity Management

The DRIS lessons learned found that the capacity management process and the baseline production model enabled the DRIS team to effectively manage change with Census Bureau stakeholders. The process allowed for timely response to frequent change (redials, case supply, productivity, etc.). The changes in dial order suggested by the capacity management team optimized the workload and proved to be a success.

5.8.5 Instrument Lessons Learned

To measure the interaction between the CFU instrument and the interviewer, this report relied on site observational reports, lessons learned documents, and a call center staff survey. Call center staff were invited to take a 30-minute online survey, which was available between July 15, 2010, and August 7, 2010. Questions were specific to each call center role, including interviewers, supervisors, SQA monitors, members of the Workforce Management team (WFM), and members of the reporting team, and questions focused on the applications used in the various roles.

Of those who completed the survey, 2,789 were CFU-only interviewers, 753 were TQA-to-CFU transition interviewers, 133 were CFU-only supervisors, 41 were TQA-to-CFU transition supervisors, 304 were members of the SQA team, 58 were WFM call center team members, eight were central WFM members, and five were central reporting members. The majority of CFU interviewers did not have previous call center experience, while over 75 percent of supervisors had previous call center experience. Of the 47 percent of interviewers who did have previous call center experience they primarily worked as agents in customer service, sales, telemarketing, and collections with an average of 2 years experience.

5.8.5.1 CFU Application

Over 80 percent of interviewers found the CFU application easy or very easy to understand. Observation reports confirmed that interviewers understood the application most of the time.

Transition interviewers reported some trouble adapting to the CFU application, with between 5 to 10 percent reporting that the application was difficult or very difficult to understand; this is likely attributable to the differences in the nature of TQA and CFU.

When asked to identify the most difficult module in the application, 27 percent said Module Q, 26 percent said Modules A and P, and 16 percent said Module G. All other modules were identified as the most difficult less than 10 percent of the time. Module Q was identified as difficult because it was rarely used and unfamiliar and the questions were vague. Modules A and P were difficult according to interviewers because the wording of questions was confusing, there were no shortcut keys that could be used, and the opening paragraph in Module P was too long. Module G was identified as difficult because Hispanic origin was not considered a race in the CFU interview and it was hard for respondents to choose the correct race category based on race descriptions.

While the interviewers felt that Modules Q, A, P, and G were the trickiest, observational reports suggested that interviewers often struggled with Modules C, D, and F at the beginning of the operation. Observers noted that interviewers seemed confused about interviewing respondents with second or seasonal homes, deleting babies born after Census Day, and dealing with roster members who were on extended hospital stays. Interviewers also were observed attempting to delete roster members by clearing all name fields in the EDITNAME screen; not only was this not allowed by the application, this would have merely deleted the name and left the rest of the person record on the household roster. Removing duplicated roster members often caused problems for interviewers; many interviewers selected the incorrect roster member to keep and then could not subsequently drop the duplicated person. Interviewers sometimes complained to observers that the instrument did not provide a way to add people; most of Module D is devoted to adding roster members, but some interviewers were not clear about the purpose of the questions in Module D. These errors were common when call centers opened, but observations of mid- and late-operational call centers showed few to no signs of these interviewer struggles. Also, the training team provided additional guidance on these issues through job aids and supplemental training.

One observer noted that some situations were difficult for interviewers to handle while still staying on script. While it is unreasonable to expect that every living situation be considered during testing, a few types of calls may have been mitigated with additional testing that went beyond the "happy path." For example, removing a deceased person from the roster was difficult for interviewers; there was no specific option or question probing for deceased roster members, so the interviewer had to indicate that the respondent did not know the deceased roster member. This proved to be a problem because the interviewer still had to read the scripted text.

Another observer found that other situations made it difficult to even conduct an interview. At the beginning of a call, an interviewer first verified the identity of the household and the housing

unit and then probed for the person who filled out the initial census form. If the initial respondent knew who filled out the census form, but that person was not immediately available, then the interviewer would attempt to set an appointment to speak with the person who filled out the census form. If no appointment was scheduled, the dialer would eventually contact that household two more times before someone other than the person who filled out the census form could serve as the respondent to the interview. While this practice was generally a great one to ensure privacy, this led to some frustrating calls where people who completed the original census form were away for the entire CFU interviewing time period, such as a military deployment or incarceration. Other household members had to wait for three contacts in order to complete the interview even though these other household members may have been willing respondents. The "Original respondent no longer lives here" option should be reworded to include situations such as these.

5.8.5.2 Functionalities

Over 68 percent of interviewers found CFU hot keys[43] useful and over 63 percent found the jump-back feature easy or very easy to use. Observers also noticed interviewers using hot keys from very early in the operation, with increasing regularity as the operation continued. Interviewers would have liked the ability to jump forward in an interview, the use of hot keys in Modules A and P, the expansion of Frequently Asked Questions (FAQs) and Help topics, and the ability to search FAQs and Help text.

While observational reports showed that the methods at the interviewers' disposal to signal a supervisor seemed to work well, interviewers requested the ability to chat electronically with supervisors to get clarifications while on calls. They also felt it would be useful to integrate interviewer's schedules with the system so that the system can remind interviewers when they should go on break or log out for the day. One lesson learned also suggested that schedules be electronic. The electronic release and storage of job aids instead of paper updates would have been nice; this suggestion was echoed in DRIS lessons learned.

Users would have liked if call center staff members were allowed access to the Census Bureau website and to initial questionnaires. Better scripted transitions, more conversational scripting, and live-call simulations during training would have helped the interviewers. They would have liked more flexibility in verbatim scoring from SQA. Additionally, interviewers reported that there were a lot of respondent concerns about the legitimacy of the interview. Positive public awareness about the CFU calls would have been useful.

The DRIS lessons learned document found that while the instrument overall was very successful and easy to navigate, some functionalities needed improvement. The ability to transfer calls was mentioned as a function that a future telephone followup operation should have. Transferring calls would have allowed an interviewer to escalate a difficult respondent to a supervisor and continue with other interviews; the 2010 CFU practice was that the supervisor had to take over

---

[43] Hot keys allowed interviewers to select interview items by pressing a keyboard button instead of pointing and clicking on the item with a mouse. For example, the CFU question "Any foster children?" in Module D had the response options "1. Yes" and "9. No." The interviewer could press the number that corresponded to the response instead of clicking the provided radio button.

the interviewer's station and mitigate any difficulties with the interviewer still connected to the call. Also, the ability to transfer calls would have allowed a call identified as a language barrier to go directly to an interviewer who could conduct the interview in the specified language; the 2010 CFU practice required the interviewer to end the call and disposition the interview as having a language barrier.

DRIS lessons learned and observation reports mentioned that the ability to end the call due to a language barrier only in Module A or P should be expanded to the entire interview. While the original design seemed reasonable, interviewers would sometimes encounter respondents who thought they could complete the interview in the interviewer's language but who ultimately found that some interview questions were beyond their command of the language. Since the interviewer could not disposition the call as a language barrier call once out of Module A or P, the dialer would end up contacting the respondent in that language again, unless the respondent called the appropriate language line first.

TQA-to-CFU transition interviewers had the opportunity to work with both applications and were asked questions during the staff survey about some of the differences in functionality. Of transition interviewers, 55 percent indicated that they liked having the opportunity to leave notes at the end of the CFU interview, over 75 percent would have liked hot keys in TQA, and over 82 percent would have liked CFU Help and FAQ to have a search function.

5.8.5.3 The Use of Soft Phones

While the majority of interviewers had not previously used a soft phone, interviewers and supervisors enjoyed that the soft phones required less desk space, displayed a call history, were hands-free and automatically answered, and made it difficult to accidentally hang up on a respondent. However, there were some audio distortion issues or static and it took some time to get used to not having a regular phone.

5.8.5.4 EyeQ360

The majority of users found eyeQ360 easy to navigate. A majority of monitors felt it allowed them to accurately evaluate interviewer performance, but a majority of monitors that responded to the survey also felt that the two to three hour delay of recording availability affected their productivity. The reporting and search functions met the needs of the users, and the audio and video quality met a majority of users' expectations.

One suggestion from the DRIS lessons learned was to give interviewers access to eyeQ360 recordings. In the 2010 CFU operation, only SQA agents and supervisors could access eyeQ360 recordings for scoring and coaching purposes; allowing interviewers to access some recordings in the eyeQ360 database for additional training purposes could potentially encourage better interviewing habits.

5.8.6 Help Desks

DRIS lessons learned suggested that there were gaps in the operational help desk requirements that should have been identified in order to better understand Call Center Operations needs for

the help desk solution. The need for a Call Center help desk in the DRIS solution did not emerge until after the 2008 Dress Rehearsal, which led to limited flexibility in the solution used and to the modification of an existing process instead of the creation of a fully customized solution. The TeleTech and DRIS help desks needed to be kept independent but with visibility, so that ticket information could be pulled from a single system. The integration of the DRIS and Call Center help desks worked effectively to ensure that all stakeholders were made aware of critical issues but also had a negative impact on the resolution time for working and escalating issues. The severity definitions were not always clear to Census Bureau stakeholders and the criteria for statusing the Census Bureau were not always appropriate to the urgency of the situation.

5.8.7 Trouble Tickets

If a technical issue arose during production, a trouble ticket was opened to investigate root causes and to fix the problem. Throughout production, a number of trouble tickets were opened that investigated observed issues from the creation of daily reports to the shutting down of entire call centers. The help desk tracked what type of ticket was being opened by category of system the ticket was requested for. Table 75 shows the percent distribution of tickets by category for a representative operational week.

Table 75: Percentage of Call Center Help Desk Tickets by Category[44]

Ticket Category	Percent of Tickets
Applications - i.e. CFU App, eyeQ360, eWFM, etc.	62
Reporting	6
Password Reset	3
IVR	1
Voice Circuit and Data Circuit	4
Hardware/Infrastructure	11
Workstations	6
Cisco – Dialer, Voice, Call Manager, etc.	7
Total	**100**

Source: DRIS Call Center Daily Reporting Slides, 8/6/2010

Each ticket opened was assigned a severity value with Level 4 as the lowest severity and Level 1 as the highest severity. Around 77 percent of trouble tickets were Level 4 tickets, excluding the management tickets to open or disable accounts. Among the ticket categories mentioned in Table 75, only Reporting had a high volume of Level 1 tickets, though the volume of Reporting trouble tickets was not very large. Voice Circuit and Data Circuit and Hardware/Infrastructure tickets had around 20 to 25 percent of their tickets assessed as a high severity; all other ticket categories had mostly Level 4 severity tickets opened and very few, if any, Level 1 tickets opened. However, because of the volume of Application tickets, most of the Level 1 tickets were eyeQ360 tickets. Level 1 tickets took the longest to close on average with less than 20 percent closing within an hour.

---

[44] This table includes percentages only for the week of August 1, 2010, but the percentages were fairly consistent over time. The percentages in this table are meant to be representative of the overall distribution.

While most tickets were minor and quickly resolved, a few of the outliers are noted here:

- On Memorial Day weekend, massive outages affected the operation. Three major issues coincided to cause the outages: Sprint, the service provider for the servers, altered something without telling the DRIS team, and the service to one server went down; a firewall issue occurred that went unnoticed for a day; and a Verizon telephone fiber to one call center was cut.

- On another occasion, a server overheated due to a power outage caused by a power station explosion, which caused the instrument to freeze.

- The telephony operations were provided by both AT&T and Verizon in order to ensure that an error with one company would not shut down the entire enterprise. Other than the issue during Memorial Day weekend mentioned above, Verizon experienced a few errors that affected the CFU operation and caused temporary outages. The use of two providers was noted as an overall success.

- EyeQ360 experienced many recording quality issues, sometimes due to unknown reasons. For one day, one call center had to have SQA agents score calls while sitting next to an interviewer and listening to the live call in order to complete the requirement of two scored calls per interviewer per day.

- A few data items displayed incorrectly in the interview: the name field in Module Q was slightly shorter than the name field in the rest of the interview, the name shown on one screen in Module B was defaulted to person one instead of the respondent, and the help text for Module H was displayed in English in the Spanish instrument. All three were fixed immediately after they were observed.

- Operational reports sometimes contained duplicate or incorrect data, were created late, or were not created. Discovered errors were corrected, and missing reports were regenerated.

The status of these trouble tickets was promptly disseminated to the central CFU team at daily Operational Command Center meetings.

5.8.8   Reporting

Multiple reports allowed the team to accurately monitor operational processes at great detail. The ad hoc reporting capability during production proved to be invaluable to supporting daily activities of all work streams and to project leadership. Overall, reporting was an important and successful aspect of CFU.

Reporting requirements were established late in the process and data sources were not identified. The sources from which the Census Bureau was receiving data and reports were not well integrated. The use of the various data sources led to discrepancies, which forced multiple

deliveries to the Census Bureau. Also, metrics were not standardized across the different data sources, which produced variances among reports and caused confusion. A better alignment of source data for deliveries to the Census Bureau was needed. Additionally, a more cohesive set of reporting requirements that included the development team, operations team, and Census Bureau needs would have helped the overall reporting solution.

5.8.9   Publicity and Awareness

The CFU instrument contained multiple resources for interviewers to demonstrate the legitimacy of the interview to respondents; this foresight was invaluable to interviewers who sometimes dealt with somewhat uncooperative respondents.

Both DRIS lessons learned and observational reports found that interviewers encountered reluctance by respondents to participate in the CFU call, especially due to concerns over legitimacy. Respondent unawareness of the CFU program created complex, sometimes hostile exchanges in CFU interviews, and public and internal Census Bureau awareness regarding the CFU program was insufficient to avoid these situations with respondents. Media outlets sometimes reported that the 2010 Census was completed or was not making phone calls to households. Despite efforts to educate staff in the field about the potential for a legitimate followup phone call, some respondents reported that they received conflicting information about the legitimacy of the CFU program. Providing more information to CFU interviewers about why a household was selected for the followup call or including such information as a part of the script may gain cooperation. Interviewers did have some tools to help respondents validate the legitimacy of the call, including directing respondents to the Census Bureau 2010 website. However, interviewer performance was impacted by an inability to access supporting documentation such as the context-sensitive Help text outside of the CFU application or the Census.gov website at any time.

5.8.10 Difficult Situations

The DRIS lessons learned found that the definition and implementation of the threat, crisis, and suicide call escalation process was initially not robust enough to handle every scenario. Many of these types of calls were not anticipated to occur during an outbound phone operation; thus processes were not clearly defined before operations began. A functionality in the application, such as a defined disposition to track fraudulent calls and threats, and a plan for dealing with these types of calls would have been helpful before operations started. By the end of the operation, manually maintained observations found that the operation had received 100 threatening calls, 85 percent during outbound calls and 15 percent during inbound calls. In addition, CFU interviewers received 12 suicide threats.

Call center staff had difficulty understanding the criteria for escalating potential Do Not Call (DNC) cases. The definition for DNC cases was expanded and more clearly outlined throughout production, and it included cases such as those identified as a GQ facility, cases caught in a bad

address loop[45], cases where physical threats were made to an interviewer or a call center, and cases where a respondent explicitly requested to be removed from the dialer list.

5.8.11 Quality Operations

SQA and DQ were both considered successes; both met or exceeded their operational goals, and both provided a way of monitoring interviewing trends and problems. The ability to evaluate calls using audio and video recordings was very valuable. A DRIS lesson learned suggested that SQA and DQ should be merged in some way since they both assess quality; this would require a refinement of SQA's current scoring criteria or a broadening of DQ's current scope. The SQA design did not allow for the more flexible scoring that was available in Data Quality. For example, in exchanges between the interviewer and the respondent that were not completely clear, DQ had the ability to account for variances, but the SQA scorecard could not capture the possibility for uncertainty.

The magnitude of the support staff for the SQA operation required its own operational considerations such as workforce management, workload management, account management, and performance management. The extent of the support was unexpected and somewhat unplanned for. Also, according to DRIS, the requirement of two scored calls per interviewer was found to provide only a slight boost to SQA scores than just one scored call per interviewer per day would have given. The second scored call did provide an increase to the number of calls audited and validated the accuracy of the scores. Daily evaluations and regular meetings with supervisors drove high quality of the operation. The central calibration sessions were a success and provided consistency to the scoring standards across the enterprise. To improve them even further, multiple call centers should view and score the same call for calibration, and non-English calls should be calibrated. In addition, the Audit-the-Auditor program provided reassurance of enterprise-wide calibration among SQAMs.

The scope of DQ evolved during the development of the program, and the intent of DQ evolved with each phase, which altered the original intent of the defined business rules. During operational tests and operations, business rules had to be redefined in order to accommodate real-life scenarios. The staff of part-time monitors produced high quality results. Census Bureau stakeholders were involved in DQ calibration sessions, which was helpful in working through exception scenarios that arose. However, stakeholder involvement sometimes varied over the course of the operation, and this variance had the potential (and did on some occasions) to create ambiguity in the implementation of business rules and scoring methods.

These suggestions stemmed from the DRIS Lessons Learned document.

---

[45] A bad address loop was where a respondent called into the CFU operation but the address in the CFU application did not match the respondent's address. Due to the verification process of inbound calls, these calls were not able to begin interviews, but the dialer continued dialing these cases. To keep such cases from being contacted many times with no possibility of completion, they were manually added to the DNC list.

5.8.12 Call Center Selection

The geographic spread of call centers across the country was a good method of mitigating the risk of a geographically-focused disaster. Site selection crossed multiple time zones to limit potential business continuity issues and ensured call coverage across the country. The cluster of sites in the Salt Lake City area did introduce some geographically-focused disaster risk and also caused labor pool issues, competition for resources within the project, and potential media concerns.

Call centers were originally assumed to be about 250 seats, and the architecture of a call center was designed around this size. The final call centers selected for CFU varied in size, some of which were three or four times the size of the assumed size. These large call centers were broken into "kits" to maintain the call center system architecture. Kit architecture mitigated risk by creating an independent "mini-call center" from a technology perspective. However, kit architecture hampered multi-kit sites from managing operations at an enterprise level and led to gaps in operational procedures. For example, account management was complex and not fully understood, there were increased costs for training resources and for cabling and workspace setup, there was lack of insight into site-level performance, and security clearances were challenging. Overall, DRIS felt that call centers with between 500 to 600 seats were the ideal size. Larger call centers were better able to adjust to large fluctuations in staffing; larger call centers would also mean fewer call centers, which would improve communication across call centers and with the central team.

5.8.13 Staffing

Table 76 shows the forecast and actual staffing by production week. Overall, the operation was understaffed when compared to the forecasted numbers. The variance drastically changed from slightly overstaffed to 40.2 percent understaffed from week 16 to week 17 due to attempts to match staffing levels to the lower-than-expected workload.

Table 76: Interviewer Headcount by Operational Week

Week	Forecast	Actual	Percent Variance
1 (4/11/2010)	448	590	31.8
2 (4/18/2010)	895	1,209	35.1
3 (4/25/2010)	2,104	1,945	-7.5
4 (5/2/2010)	3,320	3,883	17.0
5 (5/9/2010)	4,661	5,207	11.7
6 (5/16/2010)	5,893	5,537	-6.0
7 (5/23/2010)	5,819	5,403	-7.1
8 (5/30/2010)	5,781	5,339	-7.6
9 (6/6/2010)	5,705	5,441	-4.6
10 (6/13/2010)	5,594	5,592	0.0
11 (6/20/2010)	5,520	5,673	2.8
12 (6/27/2010)	5,408	5,777	6.8
13 (7/4/2010)	5,355	5,805	8.4
14 (7/11/2010)	5,296	4,894	-7.6
15 (7/18/2010)	5,221	4,870	-6.7
16 (7/25/2010)	3,320	3,495	5.3
17 (8/1/2010)	2,760	1,650	-40.2
18 (8/8/2010)	1,491	1,119	-25.0
Total	**---**	**---**	**-1.6**

Source: Phase III Deliverable

The ability to recruit and achieve staffing requirements for the project was highly influenced by the program logistics and current unemployment rate. The high national unemployment rate and the high hourly wage rate were factors in the creation of staffing models, which ultimately assumed that attrition would be lower than the industry standard. However, the short-term nature of the program had a larger impact on attrition than the high national unemployment rate, and the final CFU attrition percentage matched the industry standard. Transition sites saw more attrition than anticipated due to transition interviewers unsatisfied with the shift caused by TQA's daytime operational schedule to CFU's evening and weekend operational schedule.

Recruiting was impacted by the short-term nature of the project, the large number of resources required, and the duration of suitability approval process. Some challenges were recognized when recruiting specific skill sets such as WFM expertise, bilingual fluency (particularly those other than Spanish), quality monitoring proficiency, and experienced call center directors.

5.8.14 Training

The virtual classroom was found to be an effective training environment, and the supplemental training helped boost SQA scores. A suggested improvement would be to design a sandbox type environment so that interviewers would be able to access the CFU instrument and learn about the modules, FAQ and Help topics, and interview flow by trying it before handling real calls. While simulations were designed for this purpose, interviewers were not able to explore the instrument freely and were thus sometimes confused when interviews veered from expected pathways.

DRIS lessons learned found that training was successful. More information on the purpose of the interview questions, however, would have helped interviewers better understand their goal in handling calls, which was of particular importance to the transition interviewers who were familiar with the purpose of TQA.

Observations of training led to positive reviews of the training structure. The use of active assistant trainers who were near the trainees and identified problems that a trainer who sat far from the training group could not see was particularly noted as a success when observed. Observers did notice some inconsistencies between the training materials and operational rules as well as the contents of the training materials themselves; a more thorough review of training materials was suggested.

In some call centers, interviewers who had completed training but had yet to take any calls were placed next to an active interviewer and allowed to observe some live calls. This practice was highly praised by one observer. Both interviewers learned from each other, and the new interviewer had a chance to become familiar with the instrument without actually taking the call.

During the first day that a new interviewer handled calls, their day included some additional training after a couple of hours of handling live calls. Structuring the first day of operations at each site with meetings and training opportunities throughout the day was found to be effective. It also had the added benefit of increased on-site support personnel-to-interviewer ratio and decreased overall escalations and questions.

After the training provided to all interviewers and staff, additional training needs were identified during operations. The training solution adapted to program needs to provide additional training on areas identified as needing improvement. A total of 30 job aids, 42 row meeting documents, 31 urgent communications, eight Standard Operating Procedures updates, and 18 general information communications were developed and released during the operation. One lesson learned was that while grouping cases into buckets so that each could be opened when the workload was an acceptable level was useful, opening one led to a rush of similar case types that flooded the call centers, which confused interviewers and supervisors alike. Later in the operation, the training team distributed interviewing tips regarding specific case types when a new bucket was anticipated to be opened; such communication should continue if the bucket structure is retained in future followup operations.

5.8.15 Change Requests

Both the Census Bureau and DRIS had change request (CR) processes that identified, documented, and approved or rejected changes to the original CFU project plan. CRs were submitted throughout the lifetime of the CFU operation and affected the content of the interview, the CFU universe, and the CFU schedule.

5.8.15.1 *Census Bureau Requests to DRIS*

Four CRs were submitted to DRIS to alter the contents of the CFU interview. One allowed for a path out of Module B and into another interview module; this change allowed for the conversion of respondents who gave soft refusals by saying that the interviewer had reached the incorrect

household. Another DRIS CR requested that Module C be expanded to collect some additional information. A third DRIS CR updated some minor wording. These three were accepted, and all had a cost of zero dollars and zero hours. A fourth DRIS CR requested the addition of Puerto Rico-specific Spanish text and address fields in order to tailor the interview to respondents in Puerto Rico. This CR was approved and had a cost of $541,633.

Three additional DRIS CRs impacted the transmission of data. One requested the race and Hispanic origin write in codes. Another asked for the transmission of an additional variable that was already collected during the CFU interview. The Hispanic origin question was an umbrella question; the first question asked if the person was of Hispanic origin and had only "Yes" or "No" response options, and a follow up question to collect detailed Hispanic origin information was asked only if the first Hispanic origin question had a "Yes" response. This CR requested that the response to the initial Hispanic origin question be passed to WCM. The cost of this CR was absorbed into the contract cost. Another of these DRIS CRs was submitted and accepted to allow for the redelivery of eight CFU returns to DSSD that had initially been sent with missing data. These eight cases were sent after the HQP data acceptance deadline and were thus not included in the final CFU universe or in census results. This CR had a cost of zero dollars and zero hours.

CFU received a portion of the funds from the American Recovery and Reinvestment Act of 2009 (ARRA). This money was used to fund and open the call center in Ogden, UT. Since only ten call centers were originally planned for CFU, a CR was submitted to add this call center. The CR cost $15,176,997 and was approved.

5.8.15.2 Other Requests

Three CRs were submitted to the UCM or the Census Integration Group (CIG). One requested the change of three contingency case types to production case types, one allowed person number identifiers for added persons to start at 50 instead of 71, and the other was a schedule adjustment from ten waves to eleven waves and a slightly longer bucket drop time period to account for the data collection change in NRFU. All three were accepted.

5.8.16 Schedule

The 2010 CFU operation successfully stayed on schedule. Every item finished on or before the baseline finish date in the Master Activities Schedule (MAS). Only the creation of the control table for Wave 8 started after the baseline start date, but it still finished before the baseline finish date. See Appendix E for the full schedule.

During the DMD lessons learned sessions, many pieces of feedback related to the MAS. For example, CFU lines were missing predecessors, successors, or correct dates. In addition, similar line items in the DRIS project schedule and in the DMD master schedule duplicated efforts both in their creation and in their eventual reconciliation. The sheer size of the MAS presented its own navigational challenge as well.

6. Related Evaluations, Experiments, and/or Assessments

The following assessments, evaluations, and experiments are related to the CFU assessment.

- Alternative Coverage Followup Questions and Design Evaluation

- Evaluation of Administrative Records Use for Coverage Problems

- Evaluation of the Effectiveness of Unduplication

- 2010 Bilingual Questionnaire Assessment

7. Conclusions and Recommendations

Overall, the 2010 CFU operation was a success. Over 7,700,000 production cases were sent to DRIS, resulting in 4,536,636 completed production interviews and over 1,500,000 people added to or deleted from household rosters. The overall completion rate of all production and non-production cases in the dialer was 66.0 percent, and the overall completion rate of all production and non-production cases sent to DRIS was 60.4 percent. Despite this large workload, the 2010 CFU operation came in under budget and operated smoothly.

DCAR did not function as anticipated, which caused some confusion during interviews. This process needs more testing and verification in the future. The universe also should be examined for returns that came from residents of GQs.

The realized workload fell short of the expected workload. As a result, the call centers were overstaffed, and downscaling occurred. Also, the proportion of the workload that was expected to be Spanish was underestimated, which led to a greater demand on the Spanish bilingual interviewers. Better workload estimates should be generated in the future.

While the Call Detail Record was a promising data source, it was too erroneous to provide reliable data. Better dialer data are needed for in-depth dial analysis.

Add and delete rates from the 2010 CFU operation were similar to those from previous tests. All sources of coverage improvement performed well, but the Overcount – College source was especially effective at predicting roster changes. Similar future coverage operations should include these sources of coverage improvement, especially Overcount – College cases.

Identifying cases for followup with administrative records served as useful support for roster edits when used in conjunction with other sources of coverage improvements. As its own source of coverage improvement, AR cases did not perform quite as well as other sources. In fact, AR interviews often attempted to add college students, which is a group of commonly overcounted people. We recommend that the effectiveness of administrative records continue to be examined. We also recommend that all cases with multiple sources of coverage improvement be

modeled to better understand drivers and the relationship between the different sources of coverage improvement.

The 2010 CFU operation successfully improved demographic item non-response and should continue to be used to do so.

Both SQA and DQ showed that the data collected in the 2010 CFU operation were good. Even though additional training and job aids were created to stress the importance of reading text verbatim, this critical criterion still needs to be improved. SQA calibration sessions should continue in future coverage operations to keep scores consistent across call centers. The usefulness of scoring more questions and more interviews in DQ should be explored. As an alternative, these two programs could potentially be combined.

Technically, the instrument was quite solid. The use of the 2008 Dress Rehearsal as a test for the instrument proved successful, as did the number of tests conducted between the 2008 Dress Rehearsal and the 2010 Census.

Overall, interviewers were able to understand the CFU interview relatively easily. A few logical pathways were not completely clear, and these should be reexamined. Some functionality, such as the ability to transfer calls and the ability to disposition a call as a language barrier from anywhere in the interview, should be considered, but the interviewers appreciated the functionalities currently in the instrument.

CFU interviewers attempted to assuage respondent concerns over the validity of the interview, but a positive media presence would have helped in this pursuit. The media and all Census Bureau offices should be aware that the Census Bureau does call respondents about the information on census returns.

The training given to CFU staff was very successful, from the initial training to the last distributed communication. Adobe Connect was an efficient way of distributing the new hire training. A sandbox environment should be considered in similar training applications, though.

8. Acknowledgements

Some teams were instrumental to the success of the 2010 CFU operation, and we would like to thank them. The CFU team worked hard to oversee, design, provide guidance, and receive data throughout the development and production periods of this operation. Also, the DRIS Telephony and Call Center Operations teams made sure that CFU was executed successfully.

We recognize and thank those individuals who were instrumental in compiling and producing this report. Oluwaponmile Oloyede helped create data files used in this report, Timothy Stewart double programmed many tables in this assessment, and Janice Pentercs provided cost data. Also, the data used in the dialer section were generated by DRIS staff, and to them we are thankful.

We also would like to thank everyone who provided guidance on the direction and scope of this assessment. In particular, Elizabeth Poehler and Jay Occhiogrosso read and provided comments on an early draft of this report.

Without such assistance, this report would not have been successful.

9. References

Alberti, Nicholas (1999), "Large Household Evaluation", Census 2000 Dress Rehearsal Evaluation Memorandum D-4, May 1, 1999.

Blough, Laura (2010), "2010 Census Coverage Followup Assessment Study Plan," 2010 Census Planning Memoranda Series, No. 80, U.S. Census Bureau, May 17, 2010.

"CFU Telephony Design Document," Version 4.0, IBM Global Services, September 1, 2010.

Chapin, Maryann (2007), "Decision on the Personal Visit Component of the Coverage Followup Program," 2010 Decennial Census Program Decision Memorandum Series, No. 18, U.S. Census Bureau, November 27, 2007.

Coombs, Julia (2010a), "Observation of the 2010 Census Coverage Followup Interviews at the Sandy Vangent Call Center on April 23-26, 2010," DSSD 2010 Decennial Census Memorandum Series #M-53, U.S. Census Bureau, September 13, 2010.

Coombs, Julia (2010b), "Observation of the Training for the 2010 Census Coverage Followup Interviews at the Denver Convergys Call Center on May 3-6, 2010," DSSD 2010 Decennial Census Memorandum Series #M-54, U.S. Census Bureau, August 30, 2010.

"DRIS – CFU Application Coverage Follow Up Application (CFU) Application Design Document," Version 57, IBM Global Services, September 1, 2010.

Govern, Kelly, Kostanich, Martine, Heimel, Sarah (2009), 2008 Coverage Followup Assessment, 2008 Census Dress Rehearsal Memoranda Series, No. O-18, U.S. Census Bureau, June 3, 2009.

Heimel, Sarah K. (2010), "2010 Census Study Plan for the Effectiveness of Unduplication Evaluation," 2010 Census Planning Memoranda Series, No. 110, U.S. Census Bureau, December 8, 2010.

Housing Unit Enumeration Operational Integration Team (2009), "2010 Census Operational Plan for the Coverage Followup Operation," 2010 Census Information Memoranda Series, No. 21, April 13, 2009.

Hughes, Colleen (2010), "Observation of the 2010 Census Coverage Follow-up in Denver, Colorado on May 9-14, 2010," U.S. Census Bureau.

King, Ryan (2007), 2006 Operational Assessment: Coverage Followup Operation, 2006 Census Test Memoranda Series #I-13, U.S. Census Bureau, June 25, 2007.

King, Ryan (2010), "Observation of the 2010 Census Coverage Followup Interviews at the Kennesaw, GA Call Center on May 27, 2010," DSSD 2010 Decennial Census Memorandum Series #M-42, U.S. Census Bureau, June 30, 2010.

Kostanich, Martine (2009a), "Identification of the 2010 Coverage Followup Eligible Universe and Selection Requirements," DSSD 2010 Decennial Census Memoranda Series, No. I-06, U.S. Census Bureau, April 30, 2009.

Kostanich, Martine (2009b), "2010 Coverage Followup (CFU) Remove Overlap Requirements," DSSD 2010 Decennial Census Memoranda Series, No. I-07, U.S. Census Bureau, April 30, 2009.

Kostanich, Martine (2009c), "Request for Delivery of Administrative Record's Universe for the 2010 Coverage Followup," DSSD 2010 Decennial Census Memoranda Series, No. I -09R2, U.S. Census Bureau, September 9, 2010.

Krejsa, Elizabeth, Linse, Kyra, Karl, Leann, Van Vlek, Christine (2005), 2004 Census Test Evaluation Report #6: Residence Rules and Coverage Questions, 2010 Census Memoranda Series, Chapter: 2004 Census Test, No. 42, U.S. Census Bureau, September 29, 2005.

Krejsa, Elizabeth, Linse, Kyra, Kostanich, Martine, Heimel, Sarah, Marshall, Leah, Banz, Edward, and King, Ryan (2007), 2006 Census Test Evaluation: Evaluation 2: Coverage Improvement, DSSD 2006 Memoranda Series, No. F-05, U.S. Census Bureau, September 24, 2007.

Mellot, Leanna (2010), "Report on Observation of Coverage Followup at the Sandy, UT Affiliated Computer Services (ACS) Call Center," U.S. Census Bureau, May 24, 2010.

Murphy, Elizabeth D. (2007), "2008 Coverage Follow-Up (CFU) User Interface Usability: Observations and Recommendations from Interviewer Review of CFU Wire Frames," Statistical Research Division Research Report Series, Survey Methodology #2007-12, U.S. Census Bureau, May 22, 2007.

Palensky, Mike L., Fratino, Suzanne (2011), "2010 Decennial Response Integration System (DRIS) Best Practices and Lessons Learned," Document Number DRIS-2010-0095, Lockheed Martin Information Systems and Global Services, February 25, 2011.

Pennington, Robin A. (2005), 2004 Census Test Evaluation #8: Person Duplication, 2010 Census Test Memoranda Series, Chapter: 2004 Census Test, No. 44, U.S. Census Bureau, September 29, 2005.

Poehler, Elizabeth Krejsa (2010a), "Decision on the Workloads for the 2010 Coverage Followup and Field Verification Operations," 2010 Decennial Census Program Decision Memorandum Series, No. 28, U.S. Census Bureau, April 1, 2010.

Poehler, Elizabeth Krejsa (2010b), "Observation of the 2010 Coverage Followup first week of operations in Ogden, UT," DSSD 2010 Decennial Census Memorandum Series #M-50, U.S. Census Bureau, August 23, 2010.

Poehler, Elizabeth Krejsa (2010c), "Observation of the 2010 Coverage Followup in Kennesaw, GA," DSSD 2010 Decennial Census Memorandum Series #M-52, U.S. Census Bureau, August 26, 2010.

Poehler, Elizabeth Krejsa (2010d), "Observation of the 2010 Coverage Followup training and first week of operations in Phoenix, AZ," DSSD 2010 Decennial Census Memorandum Series #M-44, U.S. Census Bureau, August 23, 2010.

Prunty, Danquan (2010), "Observation of the 2010 Census Coverage Follow-up Operations at the Stockton, CA Call Center," DSSD 2010 Decennial Census Memorandum Series #M-39, U.S. Census Bureau, June 29, 2010.

Ross, Anne (2010), "Report on Observation of the Coverage Followup London, KY Call Center," U.S. Census Bureau, June 2, 2010.

Sheppard, Dave, Davies, Christine, Heimel, Sarah, King, Ryan, Kostanich, Martine, Linse, Kyra, Weyl, Leann, and Woltman, Henry (2007), 2005 National Census Test: Coverage Analysis, DSSD 2005 Memoranda Series, No. D-13, U.S. Census Bureau, June 25, 2007.

Stewart, Timothy D. (2010a), "2010 Census Evaluations, Experiments, and Assessments Study Plan – Alternative Coverage Followup Questions and Design," 2010 Census Planning Memoranda Series, No. 94, U.S. Census Bureau, August 18, 2010.

Stewart, Timothy D. (2010b), "Observation of the 2010 Census Coverage Followup Interviews at the Convergys Corporation in Murray, Utah, on June 22-24, 2010," DSSD 2010 Decennial Census Memorandum Series #M-47, U.S. Census Bureau, August 23, 2010.

Stewart, Timothy D. (2010c), "Observation of the 2010 Census Coverage Followup Interviews at the Phoenix Vangent Call Center on May 4-5, 2010," DSSD 2010 Decennial Census Memorandum Series #M-45, U.S. Census Bureau, July 1, 2010.

Appendix A: Additional Workload Tables

This appendix contains additional tables related to the workload. Tables A1 through A4 show the number of returns selected by wave of high-level sources of coverage improvement. Tables A5 through A8 show the number of non-English and non-Spanish language returns selected by source of coverage improvement. Tables A9 through A12 show the number of returns sent to the dialer by wave of high-level sources of coverage improvement. Tables A13 through A16 show the number of non-English and non-Spanish language returns sent to the dialer by source of coverage improvement.

Table A1: Number of Large Household Returns Selected by Wave

Wave	Number of LHH Returns Selected	Percent
1	177,126	12.3
2	189,551	13.1
3	172,657	12.0
4	200,093	13.9
5	282,954	19.6
6	253,853	17.6
7	124,838	8.7
8	19,049	1.3
9	3,616	0.3
10	533	0.0
11	18,305	1.3
Total	**1,442,575**	**100.0***

Source: CFU Analysis File

* Percentages do not total 100 due to rounding

Table A2: Number of High Count Discrepancy Returns Selected by Wave

Wave	Number of CD-High Returns Selected	Percent
1	223,248	17.0
2	196,002	14.9
3	167,215	12.7
4	162,880	12.4
5	190,182	14.5
6	160,960	12.3
7	79,030	6.0
8	35,329	2.7
9	43,637	3.3
10	28,511	2.2
11	25,171	1.9
Total	**1,312,165**	**100.0***

Source: CFU Analysis File

* Percentages do not total 100 due to rounding

Table A3: Number of Undercount (Production) Returns Selected by Wave

Wave	Number of UC Returns Selected	Percent
1	342,836	14.5
2	317,112	13.4
3	269,425	11.4
4	276,915	11.7
5	333,757	14.1
6	277,979	11.8
7	134,076	5.7
8	123,199	5.2
9	164,133	6.9
10	85,262	3.6
11	40,921	1.7
Total	**2,365,615**	**100.0**

Source: CFU Analysis File

Table A4: Number of Overcount (Production) Returns Selected by Wave

Wave	Number of OC Returns Selected	Percent
1	316,856	12.8
2	318,852	12.8
3	255,216	10.3
4	310,179	12.5
5	383,055	15.4
6	310,286	12.5
7	136,927	5.5
8	125,387	5.0
9	186,991	7.5
10	98,620	4.0
11	42,141	1.7
Total	**2,484,510**	**100.0**

Source: CFU Analysis File

Table A5: Number of Chinese Language Returns Selected by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Selected	Percent
Large Households	100	7.8
Count Discrepancies	435	34.0
High	188	14.7
Low	247	19.3
Undercount	381	29.8**
Children	39	3.1
Relatives	204	16.0
Nonrelatives	102	8.0
People staying temporarily	36	2.8
Overcount	232	18.2
In college housing	160	12.5
In the military	20	1.6
In jail or prison	1	0.1
In a nursing home	18	1.4
Person Multiple	13	1.0
Household Multiple	20	1.6
Administrative Records	174	13.6
Unduplicated Total	**1,278**	

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A6: Number of Korean Language Returns Selected by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Selected		Percent
Large Households	19		4.8
Count Discrepancies	156		39.1**
High		76	19.0
Low		80	20.0
Undercount	133		33.3**
Children		5	1.3
Relatives		81	20.3
Nonrelatives		38	9.5
People staying temporarily		9	2.3
Overcount	114		28.6**
In college housing		66	16.5
In the military		12	3.0
In jail or prison		2	0.5
In a nursing home		7	1.8
Person Multiple		18	4.5
Household Multiple		9	2.3
Administrative Records	7		1.8
Unduplicated Total	**400**		

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A7: Number of Russian Language Returns Selected by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Selected		Percent
Large Households	7		2.5
Count Discrepancies	114		40.0
High		45	15.8
Low		69	24.2
Undercount	107		37.5**
Children		9	3.2
Relatives		61	21.4
Nonrelatives		31	10.9
People staying temporarily		6	2.1
Overcount	64		22.5**
In college housing		21	7.4
In the military		3	1.1
In jail or prison		3	1.1
In a nursing home		26	9.1
Person Multiple		7	2.5
Household Multiple		4	1.4
Administrative Records	0		0.0
Unduplicated Total	**285**		

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A8: Number of Vietnamese Language Returns Selected by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Selected		Percent
Large Households	56		17.3
Count Discrepancies	73		22.6
High		26	8.0
Low		47	14.6
Undercount	109		33.7**
Children		19	5.9
Relatives		51	15.8
Nonrelatives		30	9.3
People staying temporarily		9	2.8
Overcount	63		19.5**
In college housing		37	11.5
In the military		6	1.9
In jail or prison		7	2.2
In a nursing home		8	2.5
Person Multiple		2	0.6
Household Multiple		3	0.9
Administrative Records	52		16.1
Unduplicated Total	**323**		

Source: CFU Analysis File

* Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A9: Number of Large Household Returns Sent by Wave

Wave	Number of LHH Returns Sent	Percent
1	175,828	12.5
2	188,699	13.4
3	170,571	12.1
4	198,768	14.1
5	280,439	19.9
6	249,256	17.7
7	122,691	8.7
8	18,671	1.3
9	3,069	0.2
10	498	0.0
11	638	0.0
Total	**1,409,128**	**100.00***

Source: CFU Analysis File

* Percentages do not total 100 due to rounding

Table A10: Number of High Count Discrepancy Returns Sent by Wave

Wave	Number of CD-High Returns Sent	Percent
1	220,866	17.3
2	194,752	15.2
3	164,887	12.9
4	161,518	12.6
5	188,523	14.7
6	158,183	12.4
7	77,744	6.1
8	34,423	2.7
9	41,343	3.2
10	27,461	2.1
11	9,959	0.8
Total	**1,279,659**	**100.0**

Source: CFU Analysis File

Table A11: Number of Undercount Returns Sent by Wave

Wave	Number of UC Returns Sent	Percent
1	339,748	14.7
2	315,443	13.6
3	265,935	11.5
4	274,781	11.9
5	330,981	14.3
6	273,364	11.8
7	131,777	5.7
8	119,887	5.2
9	158,198	6.8
10	82,211	3.6
11	20,135	0.9
Total	**2,312,460**	**100.0**

Source: CFU Analysis File

Table A12: Number of Overcount Returns Sent by Wave

Wave	Number of OC Returns Sent	Percent
1	315,210	13.0
2	317,893	13.1
3	252,698	10.4
4	308,722	12.7
5	380,614	15.6
6	305,358	12.6
7	134,732	5.5
8	120,248	4.9
9	177,177	7.3
10	93,211	3.8
11	26,783	1.1
Total	**2,432,646**	**100.0**

Source: CFU Analysis File

Table A13: Number of Chinese Language Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Sent	Percent
Large Households	97	7.8
Count Discrepancies	434	34.9
High	188	15.1
Low	246	19.8
Undercount	381	30.7**
Children	39	3.1
Relatives	204	16.4
Nonrelatives	102	8.2
People staying temporarily	36	2.9
Overcount	231	18.6**
In college housing	160	12.9
In the military	20	1.6
In jail or prison	1	0.1
In a nursing home	18	1.4
Person Multiple	13	1.0
Household Multiple	19	1.5
Administrative Records	173	13.9
Unduplicated Total	**1,243**	

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A14: Number of Korean Language Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Sent		Percent
Large Households	18		4.6
Count Discrepancies	156		39.6
High		75	19.0
Low		81	20.6
Undercount	133		33.8
Children		5	1.3
Relatives		81	20.6
Nonrelatives		38	9.6
People staying temporarily		9	2.3
Overcount	114		28.9**
In college housing		66	16.8
In the military		12	3.0
In jail or prison		2	0.5
In a nursing home		7	1.8
Person Multiple		18	4.6
Household Multiple		9	2.3
Administrative Records	7		1.8
Unduplicated Total	**394**		

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of the sub-categories due to rounding.

Table A15: Number of Russian Language Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Sent		Percent
Large Households	7		2.5
Count Discrepancies	114		41.0
High		45	16.2
Low		69	24.8
Undercount	107		38.5
Children		9	3.2
Relatives		61	21.9
Nonrelatives		31	11.2
People staying temporarily		6	2.2
Overcount	64		23.0**
In college housing		21	7.6
In the military		3	1.1
In jail or prison		3	1.1
In a nursing home		26	9.4
Person Multiple		7	2.5
Household Multiple		4	1.4
Administrative Records	0		0.0
Unduplicated Total	**278**		

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of their sub-categories due to rounding.

Table A16: Number of Vietnamese Language Returns Sent by Source of Coverage Improvement

Source of Coverage Improvement*	Number of Returns in Another Language Sent		Percent
Large Households	55		17.9
Count Discrepancies	72		23.5
High		26	8.5
Low		46	15.0
Undercount	108		35.2**
Children		19	6.2
Relatives		51	16.6
Nonrelatives		29	9.4
People staying temporarily		9	2.9
Overcount	65		21.2**
In college housing		37	12.1
In the military		6	2.0
In jail or prison		7	2.3
In a nursing home		8	2.6
Person Multiple		2	0.7
Household Multiple		5	1.6
Administrative Records	47		15.3
Unduplicated Total	**307**		

Source: CFU Analysis File

*Sources of coverage improvement are not mutually exclusive.

** Percentages do not equal the sum of their sub-categories due to rounding.

Appendix B: Additional Dialer Table

Table: Reasons for Ingestion Failure

Reason	Number of Cases that Failed	Percent of Failed Cases
Invalid phone number length	483,126	70.9
Invalid proxy responses	171,828	25.2
Invalid area code	20,503	3.0
Invalid phone prefix	3,790	0.6
Person response data not found	1,576	0.2
Invalid prefix and suffix	115	0.0
Age requirement failure	30	0.0
Last name requirement failure	13	0.0
APO ZIP code	11	0.0
Invalid phone number	1	0.0
Total	**680,993**	**100.0**

Source: Phase III Deliverable

Appendix C: Standard Demographic Tables

There were 18,949,674 data-defined persons included on 4,536,636 CFU forms in the 2010 Census.   This section will present the demographic characteristics for these persons on the CFU form. Tables C1-C5 give CFU person demographic characteristics: age, Hispanic origin, race, relationship to person 1, and sex.   Age was calculated based on the date of birth provided; if no date of birth was provided then the write-in age was used.   Age was calculated only if the date of birth fell within valid date ranges. Similarly, the calculated age or write-in age was used only if it fell within valid age ranges; otherwise it was considered missing. Table C6 gives the distribution of tenure responses for housing units included in the CFU operation.

Because the demographic data used in this assessment are unedited, direct comparisons with published 2010 Census results are not possible. These tables include a row for people with missing values for the specific characteristic. The data in published Census reports have undergone editing and imputation, and therefore will have no missing values.

Table C1: Standard Assessment Demographic Table for Collapsed Age

Age in Years	Overall Population in CFU	Percent of Total Population
Under 5 years	1,556,492	8.2
5 to 9 years	1,515,075	8.0
10 to 14 years	1,603,868	8.5
15 to 19 years	2,073,580	10.9
20 to 24 years	2,035,021	10.7
25 to 29 years	1,219,514	6.4
30 to 34 years	1,017,775	5.4
35 to 39 years	1,026,486	5.4
40 to 44 years	1,113,562	5.9
45 to 49 years	1,359,852	7.2
50 to 54 years	1,341,731	7.1
55 to 59 years	969,480	5.1
60 to 64 years	639,965	3.4
65+ years	1,359,058	7.2
Missing	118,215	0.6
Total	**18,949,674**	**100.0**

Source: CFU Analysis File

Table C2: Standard Assessment Demographic Table for Hispanic Origin

Hispanic Origin	Overall Population in CFU	Percent of Total Population
Not Hispanic or Latino checkbox only	13,913,104	73.4
Mexican checkbox only	2,753,818	14.5
Puerto Rican checkbox only	422,628	2.2
Cuban checkbox only	95,595	0.5
Another Hispanic checkbox only	87,897	0.5
Multiple checkboxes	44,192	0.2
Both Checkbox and Write-in	1,152,671	6.1
Write-in Only	289,785	1.5
Missing	189,984	1.0
Total	**18,949,674**	**100.0***

* Due to rounding, percentage points do not sum to the exact numbers in the table
Source: CFU Analysis File

Table C3: Standard Assessment Demographic Table for Race

Race	Overall Population in CFU	Percent of Total Population
White checkbox alone	11,380,497	60.1
Black or African American checkbox alone	2,720,830	14.4
American Indian and Alaska Native checkbox alone	50,216	0.3
Asian Indian checkbox alone	209,420	1.1
Chinese checkbox alone	289,307	1.5
Filipino checkbox alone	243,793	1.3
Japanese checkbox alone	33,555	0.2
Korean checkbox alone	84,502	0.4
Vietnamese checkbox alone	148,699	0.8
Other Asian checkbox alone	7,791	0.0
Native Hawaiian checkbox alone	16,383	0.1
Guamanian or Chamorro checkbox alone	7,198	0.0
Samoan checkbox alone	13,654	0.1
Other Pacific Islander checkbox alone	1,619	0.0
Some Other Race checkbox alone	22,506	0.1
Multiple checkboxes	331,227	1.7
Both Checkbox and Write-in	2,606,122	13.8
Write-in Only	531,048	2.8
Missing	251,307	1.3
Total	**18,949,674**	**100.0**

Source: CFU Analysis File

Table C4: Standard Assessment Demographic Table for Relationship

Relationship	Overall Population in CFU	Percent of Total Population
Householder	4,510,402	23.8
Husband/Wife of Householder	2,674,512	14.1
Biological Son or Daughter of Householder	6,417,460	33.9
Adopted Son or Daughter of Householder	226,541	1.2
Stepson or Stepdaughter of Householder	404,095	2.1
Brother or Sister of Householder	362,250	1.9
Father or Mother of Householder	348,425	1.8
Grandchild of Householder	1,174,339	6.2
Parent-in-law of Householder	158,248	0.8
Son-in-law or Daughter-in-law of Householder	234,415	1.2
Other Relative	764,451	4.0
Related*	125,697	0.7
Roomer or Boarder	208,019	1.1
Housemate or Roommate	353,853	1.9
Unmarried Partner	317,088	1.7
Other Nonrelative	551,886	2.9
Not Related*	25,385	0.1
Two or more relationships	7,005	0.0
Missing	85,603	0.5
Total	**18,949,674**	**100.0****

*This relationship category is not found on CFU or TQA returns
** Due to rounding, percentage points do not sum to the exact numbers in the table
Source: CFU Analysis File

Table C5: Standard Assessment Demographic Table for Sex

Sex	Overall Population in CFU	Percent of Total Population
Male	9,423,802	49.7
Female	9,478,872	50.0
Both	2,316	0.0
Missing	44,684	0.2
Total	**18,949,674**	**100.0***

* Due to rounding, percentage points do not sum to the exact numbers in the table
Source: CFU Analysis File

Table C6: Standard Assessment Demographic Table for Tenure

Tenure	Number of Cases Completed in CFU	Percent of Total Completes
Owned with a mortgage or a loan	2,402,562	53.0
Owned without a mortgage or a loan	694,603	15.3
Rented	1,323,848	29.2
Occupied without payment of rent	82,260	1.8
Multiple	22,042	0.5
Missing	11,321	0.2
Total	**4,536,636**	**100.0**

Source: CFU Analysis File

These distributions may vary across different census operations due to differences in corresponding populations and census procedures.

Appendix D: Additional Operational Results Table

Table: Sources of Coverage Improvement Combinations with the Highest Delete Rates

Source of Coverage Improvement*	Number of Cases Completed in CFU	Percent of Cases with Added or Deleted People	Percent of Cases with Added People	Percent of Cases with Deleted People
CDH/UCC/OCC	2,376	91.5	1.1	91.3
CDH/OCC	42,496	90.7	0.8	90.6
CDH/UCR/OCC	14,095	90.4	1.1	90.3
CDH/AR/OCC	318	85.8	3.8	85.8
LHH/CDH/UCR/OCC	272	82.4	3.3	82.0
CDH/UCT/OCC	3,026	81.8	2.1	81.3
LHH/CDH/OCC	1,062	81.3	3.0	80.7
CDH/OCN	7,680	77.4	1.0	77.1
LHH/CDL/OCC	1,074	81.3	13.5	76.4
LHH/CDH/UCT/OCC	121	74.4	7.4	72.7

Source: CFU Analysis File

*LHH=Large Household, CDL=Count Discrepancy – Low, CDH=Count Discrepancy – High, OCC=Overcount – College, OCN=Overcount – Nursing, UCC=Undercount – Child, UCR=Undercount – Relative, UCT=Undercount – Temporary, AR=Administrative Records

Appendix E: Quality Improvement Index by Call Center

Table: Average Quality Improvement Index Score by Call Center

Call Center	Average QII	Number of Calls Monitored
Denver, Colorado		
First Week	0.984	30
First Month	0.993	89
End of Operation	0.996	318
Kennesaw, Georgia		
First Week	0.975	281
First Month	0.988	746
End of Operation	0.994	2,147
Lawrence, Kansas		
First Week	0.995	589
First Month	0.997	946
End of Operation	0.997	1,136
London, Kentucky		
First Week	0.989	191
First Month	0.995	568
End of Operation	0.996	1,329
Monticello, Kentucky		
First Week	0.975	408
First Month	0.982	863
End of Operation	0.988	1,287
Murray, Utah		
First Week	0.996	72
First Month	0.993	302
End of Operation	0.997	1,427
Ogden, Utah		
First Week	0.993	14
First Month	0.993	103
End of Operation	0.998	427
Phoenix, Arizona		
First Week	0.988	550
First Month	0.990	929
End of Operation	0.991	1,161
Sandy, UT (Vangent)		
First Week	0.993	342
First Month	0.995	588
End of Operation	0.996	1,366
Sandy, UT (ACS)		
First Week	0.982	111

First Month	0.986	161
End of Operation	0.988	258
Stockton, California		
First Week	0.986	52
First Month	0.993	148
End of Operation	0.998	643
Overall		
First Week	0.987	2,640
First Month	0.991	5,360
End of Operation*	0.994	11,583

Source: DQ Metrics

* Due to an error in the call detail record, the call center for 84 DQ cases could not be determined. These 84 cases are included in the overall number but are not included in the call center numbers. Therefore, the number of cases scored by call center may not sum to the number of cases scored overall.

Appendix F: Master Activities Schedule for CFU

Table E1: Master Activities Schedule: Creation of the CFU Wave Universe Activities

Activity ID	Activity Name	Baseline Start	Actual Start	Baseline Finish	Actual Finish
10UCM-10151	Create and Make Available CFU Universe Enumeration Control Table for Wave 1	3/29/10	3/29/10	4/7/10	4/1/10
10DRIS-10152	Create and Make Available CFU Universe Enumeration Control Table for Wave 2	4/8/10	4/8/10	4/14/10	4/12/10
10DRIS-10153	Create and Make Available CFU Universe Enumeration Control Table for Wave 3	4/15/10	4/15/10	4/21/10	4/16/10
10DRIS-10154	Create and Make Available CFU Universe Enumeration Control Table for Wave 4	4/22/10	4/22/10	4/28/10	4/26/10
10DRIS-10155	Create and Make Available CFU Universe Enumeration Control Table for Wave 5	4/29/10	4/29/10	5/5/10	5/3/10
10DRIS-10156	Create and Make Available CFU Universe Enumeration Control Table for Wave 6	5/6/10	5/6/10	5/12/10	5/10/10
10DRIS-10157	Create and Make Available CFU Universe Enumeration Control Table for Wave 7	5/13/10	5/13/10	5/19/10	5/14/10
10DRIS-10158	Create and Make Available CFU Universe Enumeration Control Table for Wave 8	6/3/10	6/7/10	6/9/10	6/8/10
10DRIS-10159	Create and Make Available CFU Universe Enumeration Control Table for Wave 9	6/28/10	6/28/10	7/2/10	6/29/10
10DRIS-10161	Create and Make Available CFU Universe Enumeration Control Table for Wave 10	7/8/10	7/8/10	7/14/10	7/9/10
10DRIS-10162	Create and Make Available CFU Universe Enumeration Control Table for Wave 11	7/22/10	7/22/10	7/28/10	7/23/10

Table E2: Master Activities Schedule: Conduct Nonresponse Followup Activity

Activity ID	Activity Name	Baseline Start	Actual Start	Baseline Finish	Actual Finish
10NRFU -02600	Conduct Nonresponse Followup (NRFU)	5/1/10	5/1/10	7/10/10	7/30/10

Appendix G: Acronyms and Abbreviations

Table: Acronyms Used in this Report

Acronym	Full Phrase
ACS	Affiliated Computer Services
AR	Administrative Records
ARRA	American Recovery and Reinvestment Act
CARRA	Center for Administrative Records and Research Application
CD	Count Discrepancy
CDR	Call Detail Record
CEFU	Coverage Edit Followup
CFU	Coverage Followup
CIG	Census Integration Group
CP	Coverage Probe
CPR	Contact Performance Report
CR	Change Request
CRFU	Coverage Research Followup
DCAR	Data Capture Audit and Resolution
DMD	Decennial Management Division
DOSP	Detailed Operations System Plan
DQ	Data Quality
DRF	Decennial Response File
DRIS	Decennial Response Integration System
DSPO	Decennial Systems and Processing Office
DSSD	Decennial Statistical Studies Division
EI	External Interface
FAQ	Frequently Asked Question
GQ	Group Quarters
HQP	Headquarters Processing
HU	Housing Unit
LHH	Large Household
MAF	Master Address File
MAFID	Master Address File Identification
MAS	Master Activities Schedule
MO/MB	Mailout/Mailback
NCT	National Census Test
NRFU	Nonresponse Followup
OTDR	Operational Test and Dry Run
PMO	Program Management Office
PSA	Primary Selection Algorithm

QII	Quality Improvement Index
SIT	System Integration Test
SQA	Service Quality Assurance
TQA	Telephone Questionnaire Assistance
U/E	Update/Enumerate
U/L	Update/Leave
UCM	Universe Control and Management
UECT	Universal Enumeration and Control Table
URdbS	Universal Response Database Schema
WCM	Workflow Control and Management
WFM	Workforce Management