Quality Assurance Approaches to Census 2000 Address Listing Efforts

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1.0 Background

The success of the decennial census relies heavily on the accuracy of our address listings. The Census Bureau maintains a Master Address File (MAF). This database contains information about living quarters and their geographic location. The MAF serves as the basis to deliver questionnaires, to both areas enumerated by mail or in person. For Census 2000, many field operations contributed to the development of the MAF, including Address Listing, Block Canvassing, Reconciliation of Local Update of Census Addresses, Be Counted and Telephone Questionnaire Assistance Field Verification, and others.

2.0 Summary

With a large, temporary workforce performing the listing activities, it was particularly important to have Quality Assurance (QA) measures in place to achieve quality results. Our QA objectives were to prevent errors due to lack of understanding on the part of the lister, promote continuous improvement of performance during the operation, and protect against significant clustering of errors. Qualifying observations, dependent QA, office review, and informal review were some of the components of the QA program that we used to meet the QA objectives. This paper also looks at the QA findings and types of errors detected.

3.0 Listing Operations

Each address listing operation had similar goals to improve the coverage and accuracy of our MAF. Address Listing, Military Group Quarters (GQ) Address Listing, Block Canvassing, Reconciliation of Local Update of Census Addresses (LUCA) 99, and LUCA 98 were operations performed in preparation to Census 2000. Be Counted/Telephone Questionnaire Assistance Field Verification (BCTQAFV) was conducted after Census day, April 1, 2000. Each operation had a unique purpose or source of addresses to contribute. The Address Listing operation created a new listing of addresses. Block Canvassing and LUCA 99 updated existing listings, and LUCA 98 and BCTQAFV verified individual housing units.

3.1 Address Listing

Goal: To develop the Census 2000 address list in areas containing non-city style addresses.

Summary: In the Address Listing operation, Census listers canvassed their assignment area and listed each living quarters, recording the physical location and the mailing address or physical description. The listers identified each structure by placing a spot on a census map and updating any necessary information on their maps. This information was used to update our TIGER (Topologically Integrated Geographic Encoding and Referencing System) mapping system and MAF.

Dates of Operation: Most of the workload was completed July 1998 through February 1999. A few assignments were completed March 1999 through May 1999.

3.2 Military Group Quarters (GQ) Address Listing

Goal: To develop the Census 2000 address list for for Group Quarters on military bases.

Summary: This listing operation used the same tasks as those undertaken in Address Listing, except it was completed for Group Quarters on Military bases. We requested assistance from military personnel in providing this information.

Dates of Operation: March 1999 through May 1999

3.3 Block Canvassing

Goal: To ensure the completeness and accuracy of the Census 2000 address list for areas having predominantly city style addresses used for mail delivery.

Summary: Census listers canvassed every road and street looking for every place where people live or could live, comparing the address of each living quarters with the addresses in the Census 2000 address list. They added

addresses missing from the address list, deleted addresses in the address list that duplicated other addresses or did not exist on the ground, and ensured all addresses were assigned to the correct geographic location. The listers also updated census maps with information about the location and names of roads and streets. This information was used to update our TIGER and MAF.

Dates of Operation: January 1999 through May 1999

3.4 Local Update of Census Address (LUCA 99) Reconciliation

Goal: To create partnerships with local and tribal governments to improve their jurisdictions' address list for Census 2000 in Address Listing areas.

Summary: In LUCA 99, the MAF in Address Listing areas was given to the local government to review. Local governments provided feedback as to the completeness and accuracy of our listings. In blocks where the local governments believed our housing unit counts were not accurate, we recanvassed the block.

The tasks in this recanvassing were similar to Block Canvassing. This information was used to update our TIGER and MAF.

Dates of Operation: May 1999 through October 1999

3.5 Local Update of Census Address (LUCA 98) Reconciliation

Goal: To create partnerships with local and tribal governments to improve their jurisdictions' address list for Census 2000 in Block Canvassing areas.

Summary: In LUCA 98 the local governments were given our address list to review. Each local government supplied specific feedback containing additional housing units or corrections or deletions from our listing. This feedback was sent to a field verification.

A Census lister visited specific housing units that we could not match to the MAF. The existence, correctness, and geographic location of each address was verified. Updates to the Census maps were made as necessary. This information was used to update our TIGER and MAF.

Dates of Operation: July 1999 through December 1999

3.6 Be Counted/Telephone Questionnaire Assistance Field Verification (BCTQAFV)

Goal: The purpose of BCTQAFV was to verify the existence of housing units provided by respondents in Census 2000 and not found on the MAF.

Summary: If the an address provided by a Census 2000 respondent didn't match to an address on the MAF, but the geographic area could be identified, then the address was sent to field verification.

A Census lister visited specified housing units to determine the status of the address: verified to exist, determined not to exist, or determined to be a duplicate of an address already in the MAF. Updates to the Census maps were made as necessary. This information was used to update our TIGER and MAF.

Dates of Operation: July 2000 through August 2000

4.0 QA Objectives

The general QA objectives for the address listing operations were to: 1) prevent errors due to lack of understanding on the part of the lister, 2) promote continuous improvement of performance during the operation, and 3) protection against significant clustering of errors.

5.0 QA Program

In order to meet the above objectives, we developed a QA program with approaches specific to each operation. In most cases, there were four components: Initial Observation, Dependent QA, Office Review, and Informal Review. Each component contributed to achieving a quality product and the overall QA objectives.

5.1 Qualifying/Initial Observation

During the first few days, the supervisor accompanied and observed each Census lister to ensure that they could produce work according to the established procedures. To focus on protection, 100 percent of the listers were observed.

Upon completion of the Initial Observation, with no critical errors, the lister could continue to work alone. With one or more critical errors, the work done prior to the observation was reworked, the lister was retrained, and given one more opportunity to qualify. Supervisors were instructed to release any lister who failed to qualify after a second observation, and the lister's work was reassigned to a qualified lister.

During an Initial Observation some of the tasks checked are as follows:

- Enter the correct action code
- Work in the correct block.
- Inquire about the address
- Accurately correct a listing.
- Add housing units as necessary
- Annotate adds correctly
- Make corrections and/or updates to the map when necessary
- ID duplicate listing(s)

5.2 Dependent QA

For many of the operations, one work assignment took approximately three days for a lister to complete. For the dependent QA, supervisors selected a random sample of completed work at regular intervals, or upon the completion of the work assignment.

If the sample reviewed by the supervisor did not pass, the lister was retrained. Any completed work in the failed work assignment was redone. For the Military GQ Address Listing Operation, the lister reviewed a sample of their own work, and corrected it as necessary. In LUCA 98 and BCTQFV this rework was done by the supervisor, as a continuation of the dependent QA check. In Address Listing and LUCA 99, the failed work assignment was reworked by another lister. Similar to Initial Observations, listers were given one more chance to meet quality standards before they were removed from the program.

Sample selection methods, sample size, and sampling rate varied depending on the average assignment size of the operation, production rates, and required average outgoing quality level (AOQL).

5.3 Office Review

Census clerical staff performed a review of the listings for legibility, completeness, and consistency. All the assignment areas were reviewed before they were shipped from the local office for data capture at our National Processing Center. Noncritical errors were fixed if the information was available. If the critical errors in the assignment exceeded 5%, the assignment was returned to the field for repair.

5.4 Informal Review

After each QA reviews, supervisors gave feedback to the listers regarding their performance. Both positive and negative aspects of the listers' work performance could be discussed. The feedback could also be expanded to address more quality issues than those specifically identified by the more formal QAs. It was not required that this quality improvement measure be documented.

Informal reviews were also an opportunity to ask questions or clarify any procedures.

5.5 Operational Implementation

The following table shows which of the four components were used during the listing operations:

	Initial Obs	Dep QA	Office Review	Informal Review
Address Listing	Y	Y	Y	Y
Military GQ	N	Y[2]	Y[2]	N/A[3]
Block Canvass	Y[1]	Y	Y	Y
LUCA 99	Y	Y	Y	Y
LUCA 98	Y	Y	Y	Y
BCTQAFV	Y	Y	Y	Y

[1] In addition to an initial observation, block canvassing also implemented a weekly observation of the listers.
[2] Military GQ had a combined Dependent QA and Office review.
[3] Since the QA was conducted by the listers themselves, the informal review was not necessary.

6.0 QA Results

All of the QA results that follow are preliminary, and subject to revision.

6.1 Qualifying/ Initial Observation Results

Results from the initial observation indicate that most of the listers were able to complete their job responsibilities well. No errors were observed for **92.9 %** of the listers. 7.1% of the listers had difficulty with one or more of their assigned tasks.

The following table presents each address list operation and the percentage of forms containing 0, 1, or 2 or more errors during the initial observation.

	0 errors	1 error	2 or more errors
Block Canvassing	89.43 %	7.24 %	3.33 %
LUCA 99	93.31 %	2.30 %	4.39 %

LUCA 98	93.72 %	2.76 %	3.52 %
BCTQAFV	95.16 %	2.07 %	2.77 %

Not all tasks were required or tracked for every operation. For Block Canvassing, seven errors were checked, the most common being: Not inquiring properly about the address (31.56 %), and entering the incorrect action code (27.78 %). For LUCA 99, LUCA 98, and BCTQAFV, entering the incorrect action code was the most common error. 'Not inquiring properly about the address' was not an applicable error for these other operations.

The percentage of listers who successfully passed the initial observations with no errors seems to decrease as the complexity of the task increases (as indicated by the number of defined errors). In LUCA 99 and LUCA 98, four errors were defined for the initial observation. In BCTQAFV only three errors were defined.

Results of the Initial Observation were documented on a QA form, using one page per lister, per observation. After the appropriate action was taken by local supervisors, the forms were collected to be compiled for national review. Address Listing is the exception. The initial observations were contained in the address binder, and results were not compiled.

6.2 Dependent QA Results

Block Canvassing and LUCA 99 operations consisted of a complete canvassing of a Census block. During the operation, each prelisted housing unit (HU) was given an action code indicating the existence of that HU. Additional HUs were added to the listing pages. The Dependent QA focused on the accuracy of both the listings and the map.

In the first column of the following table are items checked in the dependent QA. Some of the LUCA 99 errors were different from how they existed for Block Canvassing. The percentages reflect the distribution, and the contribution of a particular error to the total number of errors identified.

	Block Canvassing	**LUCA 99**
incorrect (or missing) action code	42.61%	25.23%
missing HU/special place (SP)	17.01%	26.33%
nonexistent HU/SP	16.58%	

incorrect physical address and/or mailing address	10.68%	17.10%
missing feature on assignment area (AA) map	6.55%	13.14%
incorrect feature on AA map	3.42%	11.16%
duplicate HU/SP	2.20%	
nonexistent feature on AA map	0.95%	7.03%

LUCA 98 and BCTQAFV listers were responsible for verifying individual addresses. The only critical error in the LUCA98 dependent QA check was if a housing unit was incorrectly deleted. For BCTQAFV two types of errors were recorded, and are evenly split, as follows:

	Incorrect or Missing Action Codes	**Incorrect Map Updates**
BCTQAFV	49.93 %	50.07 %

Military GQ Address Listing had a combined dependent QA and office review. The distribution of errors is as follows:

Incorrect Transcription	**Map spot number in the incorrect block**	**Incorrect Geocode**
27.59 %	41.38 %	31.03 %

The average across the six address list operations shows that 95.61% of the dependent QA passed with acceptable quality. Work that did not meet the acceptable quality level was reworked. It was anticipated that most of the work completed would pass the dependent QA.

The following table presents a breakdown of the results from the Dependent QA operations:

	Percent that Passed the Dependent QA
Address Listing	97.65%
Military GQ	98.51%
Block Canvass	98.04%
LUCA 99	96.60%

LUCA 98	89.90%
BCTQAFV	92.94%
Average across Address List Operations	95.61%

Assignments for LUCA and BCTQAFV operations were made based on inconsistencies that needed to be resolved, and may have been more difficult assignments than the other operations.

6.3 Office Review Results

Address Listing is the only one of these operations where we tracked the office review results. **97.92%** of assignments passed office review.

The office review form was contained in the assignment binders. Similar items were checked for each operation.

The critical errors for the Address Listing operation are:

- Lister did not canvass all blocks within the Assignment Area (AA) and/or did not return Address Register (AR) and ALL block maps for the AA
- A map-spotted Living Quarter (LQ) is not listed
- A LQ listed in the AR is not map spotted with a number that is unique for each structure within a block
- A road name listed in the AR is not shown on the map
- A LQ listed in the AR does not have a house number/road name or road name/physical location description
- A SP/GQ listed in the AR does not have the SP name and GQ name entered

Noncritical errors, such as illegible annotations, missing maps, valid ZIP codes, and names for map features were tracked and corrected when possible.

6.4 Informal Review

Results of this quality improvement initiative were not measured. It is assumed that this was valuable in reducing errors.

7.0   Conclusion

The address listing operations from Census 2000 were critical to the success of Census 2000. The QA programs we implemented for the address listing operations had to ensure that the resulting address list was accurate and as complete as possible.

To achieve that goal, we developed a comprehensive QA approach that not only included the addresses and data being collected during the address listing operations, but also the quality of work being performed by the listers. Census 2000 is widely believed to be the best census ever conducted by the U.S. Census Bureau. Our ability to ensure the quality of the address list we developed played a significant role in that achievement.

8.0   References

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