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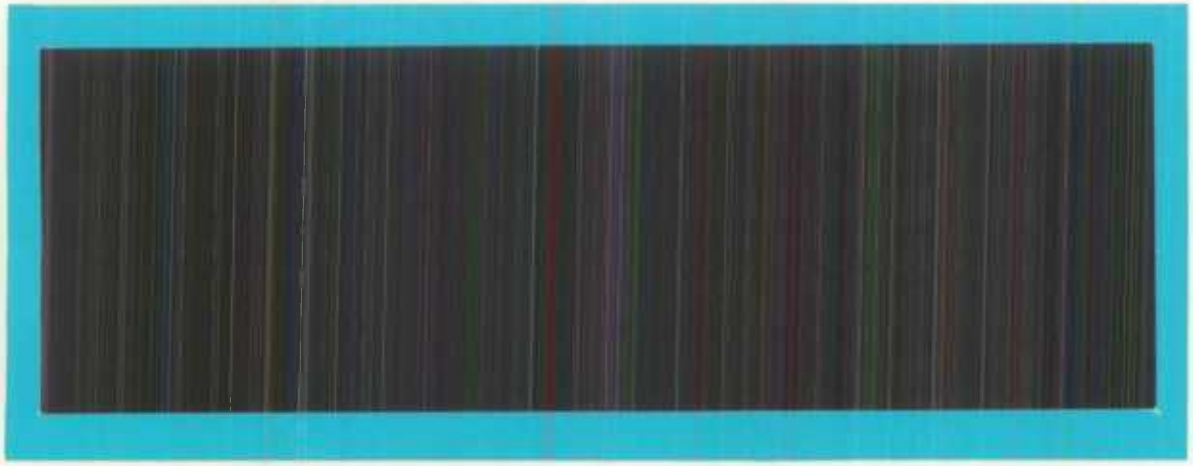

Methodology Branch

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WORKING PAPER

METHODOLOGY BRANCH

FIELD TEST FOR CENSUS COLLECTION

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SUMMARY

Statistics Canada maintains an address register (AR) of all residential dwelling addresses for urban centres with population 50,000 and over. The test was conducted to evaluate two methods of creating an up-to-date list of all residential dwelling addresses in the urban areas for the mail-out of census questionnaires. The two methods are: (i) updating the AR in the field, and (ii) listing all residential dwelling addresses in a Visitation Record (VR) booklet in the field. The methods have been evaluated by comparing the costs, and the undercoverage and overcoverage rates of the two methods. The AR updating method is recommended on the basis of cost consideration and due to better coverage. The impact on the cost and coverage due to making contact with the householder has also been evaluated.

RÉSUMÉ

Statistique Canada maintien un registre des adresses de tous les logements résidentiels situés dans les centres urbains ayant une population de 50 000 habitants et plus. Cet essai sur le terrain a été mis en place pour évaluer deux méthodes pour concevoir une liste fiable d'adresses de logements residentiels dans le but de créer une liste d'adresses postales nécessaire à l'envoi par la poste des questionnaires du recensement de la population. Ces deux méthodes sont: (i) mise à jour sur le terrain du registre des adresses, et (ii) listage sur le terrain de toutes les adresses de logements résidentiels dans un registre de visites. Les méthodes ont été évaluées en comparant les coûts de même que les taux de sous-couverture et de sur-couverture des deux méthodes. Étant donné les coûts moindres ainsi qu'une meilleure couverture, la méthode de la mise à jour sur le terrain du registre des adresses est recommandée. L'impact sur les coûts et la couverture d'un contact avec un des résidants du logement a aussi été évalué.

1. INTRODUCTION

The current census collection methodology is based on drop-off/mail-back of census questionnaires. The census questionnaires are mailed-back by the respondents to the Census Commissioner. The questionnaires are edited by the enumerators and field follow-up takes place before the completed questionnaires are shipped to processing. A new collection methodology "Centralized Edit Methodology" is being considered for the 2001 Census subject to successful testing during the 1996 Census (Hicks et al; 1993). Under the new collection methodology, the questionnaires will be mailed-out to all private residential dwellings in urban areas. The respondents will be requested to mail-back the completed questionnaires to a number of central locations called District Offices. For mail-out purposes, an up-to-date list of all residential dwelling addresses will be required for the urban areas. Statistics Canada currently maintains a residential address register (AR) for urban centres with population 50,000 and over. The AR covers approximately 63% of all residential dwelling addresses in the country. The AR was originally created from various administrative files, e.g., Revenue Canada taxation files, telephone company billing files, hydro billing files, etc. (Swain et al; 1992). The AR is periodically updated using residential addresses from administrative sources. The AR was also updated in 1993 using data from the 1991 Census Visitation Records (VRs).

The objective of the field test was to evaluate two methods of creating an up-to-date list of residential dwelling addresses by comparing coverage and cost. The two methods are: (i) updating the AR in the field, and (ii) listing all residential dwelling addresses in a VR booklet in the field. Moreover, the impact on the coverage and cost of attempting contact with the householder was also investigated. The methodology of the field test is given in section 2. The field procedures followed during the test are described in section 3. The results of the coverage evaluation are reported in section 4. A special Time and Cost Study was also conducted during the test to obtain detailed cost (Time and Mileage) estimates for each field operation. These results are reported in section 5. Finally, the conclusions and some recommendations are given in section 6.

2. METHODOLOGY

The test of creating an up-to-date list of dwelling addresses for census mail-out was conducted in October 1993 in the Census Metropolitan Area (CMA) of Ottawa/Hull. A sample of 32 census Enumeration Areas (EAs) was selected using a stratified two-stage simple random sample design with sampling of Census Commissioner Districts (CCDs) in the first stage and EAs in the second stage (Béland; 1993a). The sample of EAs was clustered within CCDs to facilitate collection and supervision in the field. In some cases, 2 or 3 CCDs were grouped together to define the first stage sampling units as explained later.

First, four broad dwelling type categories were defined from the more detailed dwelling type categories given in Appendix (C). The four broad dwelling type categories are as follows:

1. apartment in a building with less than 5 storeys,
2. apartment in a building with 5 or more storeys,
3. single detached,
4. all other types.

Then the dwelling type distribution for the four broad categories was obtained for each EA from the 1991 Census. An EA dominant dwelling type code was assigned for each EA from the above dwelling type distribution, e.g., an EA was assigned "single detached" as dominant dwelling type code if there were more single detached dwellings in the EA than any other dwelling type. Next, the distribution of EAs by their dominant dwelling type codes within the CCDs was checked to make sure that each dominant dwelling type EA was represented within each CCD. If necessary, the CCDs were grouped together within the Federal Electoral Districts (FEDs) so that there was at least one EA of each dominant dwelling type code in each CCD or grouping of CCDs.

In the first stage, a stratified simple random sample of 8 CCDs (or groupings of CCDs) was selected by taking a sample of 6 CCDs (out of 61) from Ottawa and 2 CCDs (out of 20) from Hull. A stratified simple random sample of 4 EAs (one from each dominant dwelling type code) was selected from within each sampled CCD or grouping of CCDs. Thus the sample of 32 EAs was clustered in 8 CCDs (or groupings of CCDs), and one EA was selected from each dominant dwelling type code within each sampled CCD (or grouping of CCDs). It should be noted that the sample of CCDs was allocated between Ottawa and Hull on a proportional basis, and the sample of 32 EAs was considered due to budgetary constraints. The EAs with less than 250 dwellings were given zero probability of selection so that the sample would be representative of "normal" size EAs. The smaller EAs were not grouped with the adjacent EAs because it would have resulted in a very large number of dwellings for the grouped EAs. The distribution of dwellings by broad dwelling type and the EA dominant dwelling type code for each of the 32 sampled EAs are given in Appendix (A).

As the main objective of the field test was to compare the two listing methods (AR updating method versus VR listing method) with respect to cost and coverage, both methods were applied in each of the sampled EAs. Moreover, contact with the householder was attempted in half of the EAs with one method and in the other half of the EAs with the other method. This was done to evaluate the impact of contact with the householder on the cost and coverage.

There were 4 teams of enumerators for the field work and each team consisted of 8 enumerators and one crew leader (CL). Each crew leader team of 8 enumerators was divided into two groups of 4 enumerators each, say group A and group B, so that the 4 sampled EAs within a CCD could be assigned to the 4 enumerators in a group. The field work during the enumeration phase was completed in two weeks using both the AR and VR methods. The sample of 32 EAs was divided into 4 crew leader assignments where each crew leader assignment consisted of 2 CCDs with 4 sampled EAs in each CCD. The assignment of 8 CCDs and the corresponding method of enumeration to the 4 crew leaders and the groups of enumerators in the crew leader team during the two enumeration weeks was as follows:

		Week 1			**Week 2**		
CL	Group	CCD	Method	Contact	CCD	Method	Contact
1	A	1	AR	Yes	2	VR	No
	B	2	AR	Yes	1	VR	No
2	A	3	AR	Yes	4	VR	No
	B	4	AR	Yes	3	VR	No
3	A	5	VR	Yes	6	AR	No
	B	6	VR	Yes	5	AR	No
4	A	7	VR	Yes	8	AR	No
	B	8	VR	Yes	7	AR	No

The 4 EAs within a CCD were randomly assigned to the 4 enumerators in the group corresponding to that CCD during the particular week. The contact with the household was attempted during the first week only, and there was no contact with the household during the second week. The above assignment of CCDs to the crew leaders achieves a "balance" with respect to the two factors under investigation. The two factors are: (1) the method of listing with two levels (i.e., AR and VR), and (2) the contact/no-contact with the householder with two levels (i.e., Yes and No). We can obtain unbiased estimates from the above design because:

1. half of the crew leader teams will use AR method first, and the other half of the crew leader teams will use the VR method first,

2. each team will use both the methods but no team will canvass the same CCD with both the methods,

3. each EA will be canvassed with both the methods but half of the EAs will be canvassed with the AR method first and the other half of the EAs will be canvassed with the VR method first,

4. each method will be used with "contact" in half of the EAs and with "non-contact" in the other half of the EAs in such a way that "contact" with one method implies "non-contact" with the other method and vice versa for any given EA.

3. FIELD PROCEDURES

The field work done by the enumerators can be classified into the following categories:

- updating the address register (AR),
- completing the visitation record (VR) booklets by listing residential dwelling addresses,
- reconciling the differences between the AR and the VR booklets by a field check.

After being trained by Survey Operations at Head Office, the crew leaders' (CLs) duties included supervision and training of the enumerators in their teams. Besides training and supervision of the enumerators, the CLs were also responsible for implementing the Quality Control (QC) procedures during the field work.

In addition, a special Time and Cost Study was conducted to obtain more detailed information on the cost of enumeration using the two methods. Both the enumerators and the crew leaders participated in the Time and Cost Study which required keeping a record of Time and Kilometres for various activities during the test. The Time and Cost Study is described in section 5.

3.1 AR Updating

For each EA, a pre-printed address register booklet was produced using the address register (AR) file of residential dwelling addresses. The AR was created using files of dwelling addresses from different administrative sources (e.g., telephone billing files, Revenue Canada taxation files, etc.), and was updated during the 1991 Census using the visitation record (VR) booklets during a reconciliation process. In addition, the telephone billing file for September 1993 was used to add new dwellings to the AR for the test EAs. In the AR booklet, the following variables were pre-printed:

- EA identification,
- sequence number of the dwelling address,
- block number within the EA,
- complete dwelling address (civic number, street name and designator, and street direction and/or apartment/unit number, if applicable).

Using the EA maps, enumerators updated the pre-printed AR booklets corresponding to the sampled EAs starting at the northwest corner of a block in an EA. Each block within the EA was canvassed to update the AR. The blocks were canvassed in the ascending sequence of block numbers. During updating,

enumerators would be faced with one of the three situations. These situations and the corresponding actions are described as follows:

- The address listed in the AR corresponds to a residential dwelling within the EA boundaries. The enumerators would enter additional information such as dwelling type and dwelling status codes and keep the address in the AR.

- The address listed in the AR does not correspond to a dwelling (i.e., the dwelling does not exist), or corresponds to a non-residential dwelling (e.g., commercial dwelling, etc.), or is a duplicate address, or corresponds to a dwelling located outside of the EA boundary. The enumerator would flag the dwelling and enter additional information (i.e., dwelling status code) and/or comments.

- The address of a residential dwelling is not listed in the AR. The enumerator would write the complete address at the end of the AR listings as well as the additional information such as dwelling type and dwelling status codes.

3.2 VR Listing

For each EA, a blank visitation record (VR) booklet was completed by an enumerator in the field by obtaining the following information:

- complete dwelling address,
- dwelling type code,
- dwelling status code,
- occupancy status.

Using the EA maps, enumerators listed addresses in the VR booklet by block, i.e., completing one block before starting with the next block. The blocks were canvassed in the ascending sequence of block numbers. The residential addresses within a block were listed by starting at the northwest corner of the block and proceeding in the clockwise direction.

3.3 Reconciliation

During reconciliation between the updated AR and the VR listings of an EA, the enumerators compared the addresses in the updated AR with those in the VR. The addresses which matched on both lists were marked in the AR and the pre-printed household numbers on the AR were transcribed on the VR at the corresponding addresses.

For those addresses which did not match, enumerators transcribed them on the specially designed forms (List of Differences) for listing the differences between the updated AR and the VR listings. There was one form for each of the methods (i.e., AR updating and VR listing methods) for each EA. Addresses that were in the updated AR and not on the VR listings were entered in the list of differences associated with the AR and vice versa. It should be noted that the addresses which had been flagged as invalid on the AR were not matched with an address in the VR as these addresses had to be deleted from the AR.

After completing the "Lists of Differences", the enumerator returned to the EA to determine if the addresses listed represented valid dwellings which had been missed during completion of the VR in the

case of "List of Differences" for the AR, or were missed or flagged as invalid during updating of the AR in the case of "LIST of Differences" for the VR. Using both the lists and the EA map, the enumerator attempted to make contact with the householder of the listed dwellings. After making contact, the enumerator completed the remaining information needed on the list of differences. If the information had already been completed during enumeration, it was simply verified at the time of reconciliation. If after several attempts contact was not successful, the required information was obtained by talking to the neighbours or by observation. These additional variables (especially dwelling status codes) were used later to determine whether these addresses were "over-covered" or "under-covered" by each method.

3.4 Quality Control Procedures

The main objectives of the Quality Control during AR updating and VR listing operations were:

- to build quality into the system to ensure complete coverage of valid dwelling addresses rather than relying on inspection to protect against major errors,

- to improve coverage, i.e., reduce coverage errors through feedback on the magnitude and types of errors.

For the AR updating method, two strings of 8 addresses each were selected randomly from the initial AR listings of each EA. Crew leaders were given an AR booklet where these sampled addresses were flagged. The crew leaders were asked to update the two strings of addresses using the same procedures as the enumerators would follow for AR updating. The two strings were updated in advance of the actual updating of the AR for the EA. The updated strings were then used to evaluate the work performed by the enumerators on each EA. Once an EA was completely updated by an enumerator, the updates of the two strings of 8 addresses performed by the crew leader were compared with those performed by the enumerator on the same two strings of addresses. For an EA, if the number of errors attributable to the enumerator was greater than or equal to 2 the EA was rejected and the enumerator was required to completely verify his work in the field. If the number of errors was less than 2 the enumerator's work was accepted for that EA and the error was corrected if applicable. For more details on the QC procedures during AR updating operations, see Béland (1993b).

For the VR listing method, two blocks were randomly selected from each EA in the Head Office and the EA maps were marked with an "X" on the northwest corner of the selected blocks. The crew leaders listed 6 consecutive addresses from the sampled blocks starting from the northwest corner identified by an "X" and listing dwellings in the clockwise direction. The QC sample listings for the VR method were also done in advance of the actual EA listings and used the same listing procedures as would be used by the enumerator. These two listings of 6 addresses each were used to evaluate the work performed by the enumerator in the EA. Once an EA was entirely listed by an enumerator, the crew leader listings of 6 addresses in each of the two sampled blocks were compared with the corresponding two listings of 6 addresses listed by the enumerator and the number of discrepancies was determined. The decision rules with regards to the quality of enumerator's work were the same as those for the QC procedures for the AR updating. For more details on the QC procedures for VR listing operations, see Béland (1993c).

4. COVERAGE EVALUATION

In the test, coverage can be measured using the status codes as assigned to each dwelling address by the enumerators. For coverage evaluation purposes, it is only important to know whether or not the status

code indicates a valid dwelling. The definitions of the dwelling status codes are given in Appendix (B). The dwelling status codes will be classified into two groups:

A : valid dwelling address for the EA,

B - I : invalid (or other) addresses.

The dwelling addresses on the updated AR and the VR listings were matched manually and the differences were reconciled in the field. The procedures for reconciliation are described in section (3.3). The field follow-up for reconciliation was required in the following situations:

1. dwelling address is listed in the VR booklet with valid dwelling status code but it is missing from the updated AR,

2. dwelling address appears on the updated AR with a valid dwelling status code but it is missing from the VR booklet,

3. dwelling address is present on the AR with invalid dwelling status code but it is listed in the VR booklet.

It should be noted that a dwelling address listed in the VR booklet cannot have an invalid dwelling status code as the enumerators were required to list only the valid dwellings for the EA. Therefore, no follow-up was required if an address was present on the updated AR with an invalid dwelling status code and the address was not listed in the VR booklet.

After reconciliation, an "ideal address list" was created by taking all dwelling addresses which were either valid according to both the sources (i.e. the VR and the updated AR) or were determined to be valid during the field reconciliation. The category "invalid or other addresses" includes out-of-scope dwelling addresses (e.g., commercial dwellings, non-existent dwellings, etc.), duplicate addresses, addresses outside the EA boundary, etc.

A dwelling is considered covered if its status indicates that it is a valid dwelling. Since the real (or true) status codes are not known for all dwelling addresses, the dwelling status code of a dwelling on the ideal file will be considered the real (or true) status of the dwelling. Thus for the purpose of comparing the two methods, the coverage will be evaluated with respect to the "ideal file" which has been created by matching the VR and the updated AR address listings and resolving the differences by a field check.

Two types of coverage discrepancies can occur:

A. Undercoverage

A valid dwelling is given a status code in the group of invalid dwellings or has been completely missed at enumeration. The undercoverage rate is the number of such dwellings divided by the number of valid dwelling addresses (i.e., number of dwelling addresses in the ideal list) expressed as a percent.

B. Overcoverage

An address with a real status code for an invalid dwelling has been given a status code in the group of valid dwellings. Note that according to the above definition, listing a valid address more than once will assign an invalid status to all listings of the address except the first one. The overcoverage rate is defined as the number of such cases (i.e., address listings) divided by the number of valid dwelling addresses according to the ideal file expressed as a percent.

First we compare the undercoverage and overcoverage rates of the initial AR, the AR updating and the VR listing methods. These are given in table (4.1) below:

Table (4.1): Undercoverage and Overcoverage Rates by Method.

Method	Undercoverage Rate	Overcoverage Rate
Initial AR	3.0%	2.1%
AR Updating	1.5%	0.4%
VR Listing	3.1%	2.2%

Most notable are the undercoverage and overcoverage rates of the VR listing method (3.1% and 2.2% respectively). The initial AR without any field updates is comparable to the VR listing method with respect to the coverage, i.e., undercoverage and overcoverage. Thus the AR updating method is significantly better than the VR listing method both for undercoverage and overcoverage. We also further investigated the overcoverage rate of the VR listings. It was discovered that an apartment building with 50 dwelling units was listed in error as part of an EA due to the EA boundary problem. The apartment building in question was discovered to be outside of the EA during reconciliation. The VR overcoverage would have been 1.8% instead of 2.2% had this building not been listed as part of the EA. The undercoverage of 1.5% in the updated AR was also further investigated and it was found that 1.2% of the undercoverage was due to missing valid dwellings during AR updating. The remaining 0.3% was due to deleting valid dwellings from the AR during updating, i.e., these dwellings were on the initial AR and were incorrectly flagged as invalid by the enumerators during updating.

For the 1991 Census, the AR was used for coverage improvement whereby addresses on the AR which were not listed by the enumerators on the VR during the drop-off were checked in the field and valid dwelling addresses were added to the VR. This procedure resulted in just over one half of a percent point improvement in the coverage for the Street Network File (SNF) areas. We evaluated the coverage of the improved VR by simulating the coverage improvement procedure for the test. We recall that the AR had been updated from the 1991 Census but these updates were not used for coverage improvement. The undercoverage rate for the improved VR using the AR was 0.3% as compared with the undercoverage rate of 3.1% for the VR without the improvements from the AR. The much larger decrease in the undercoverage rate by using the AR for the test as compared with that for the 1991 Census could

possibly be due to the improvements made to the AR between 1991 and 1993. For example, the undercoverage in the AR used for the test was only 3.0% as compared with the undercoverage of 13.0% in the AR used during the 1991 Census. Moreover, the quality of geocoding of addresses has been improved significantly. Therefore, we can conclude that the use of the AR for coverage improvement with the VR would give better coverage as compared with the coverage obtained by using the AR as prelist and updating in the field i.e. update/drop-off methodology.

We also evaluated the undercoverage and overcoverage by dwelling type (for 4 broad categories) for the two methods. Table (4.2) below gives the undercoverage and overcoverage rates for the two methods by type of dwelling for the four broad categories.

Table (4.2): Undercoverage and Overcoverage Rates by Method and Dwelling Type.

	Undercoverage rate (%)		Overcoverage rate (%)	
Dwelling Type	AR Updating	VR Listing	AR Updating	VR Listing
Apt. in bldg. < 5 storeys	2.4	6.7	0.6	2.2
Apt. in bldg. >= 5 storeys	0.4	0.5	0.2	3.9
Single detached	0.9	1.5	0.4	1.3
Other	2.5	4.3	0.4	2.6
All dwellings	1.5	3.1	0.4	2.2

From the above table we can conclude that "apartments in a building with less than 5 storeys" and "other dwelling" types are the most difficult to enumerate because these have higher undercoverage as compared with the other two categories both for the AR and VR methods. The overcoverage was highest for the category "apartment in a building with 5 or more storeys" with the VR method which was actually due to an EA boundary problem as mentioned earlier. The overcoverage was also high for the category "apartment in a building with less than 5 storeys" for both methods.

Next we examined the impact of contact on the undercoverage and overcoverage with the two methods. Table (4.3) below gives the undercoverage and overcoverage rates by method and contact.

Table (4.3): Undercoverage and Overcoverage Rates by Method and Contact.

Method	Contact	Contact Rate	Undercoverage Rate (%)	Overcoverage Rate (%)
AR Updating	YES	31.1	1.2	0.4
	NO	N/A	1.8	0.4
VR Listing	YES	17.9	2.4	1.0
	NO	N/A	3.9	3.3

Out of the 32 EAs in the test, contact was to be attempted in half of the EAs with the AR method and in the other half of the EAs with the VR method. The contact rates were 31.1% and 17.9% with the AR and VR methods respectively. The low contact rates were mainly due to "no one at home" at the time of making the attempt and the refusal rates were only 0.4% and 0.1% for the AR and VR methods respectively. Moreover, four enumerators did not attempt any contact in the four EAs with the VR method due to not properly understanding the procedures which explains the further drop in the contact rate for the VR method. If we exclude these four EAs the contact rate for the remaining 12 EAs where contact was attempted with the VR method would be 22.7%.

As can be observed from table (4.3), the contact has a positive impact on the undercoverage and overcoverage for both methods. It should be pointed out that the EA with the boundary problem which resulted in listing 50 dwellings in error for the VR method was assigned to "non-contact" and hence very high overcoverage for the VR method with no contact. If we exclude these 50 dwellings the overcoverage rate would be 2.5% for the VR method with no contact.

The impact of contact on the coverage of different broad dwelling type categories was also investigated. It was observed that contact had positive impact on the overcoverage for all dwelling types with both methods except for the category "apartment in a building with less than 5 storeys" for the AR method for which the overcoverage was already quite low. As for undercoverage, the contact has positive impact for all dwelling types with both methods except for the category "apartment in a building with 5 or more storeys" for both methods and for the category "single detached" for the AR method. In these cases, contact does not reduce the undercoverage since the undercoverage rates are already quite low.

The quality of the dwelling type codes for the 9 dwelling type categories (Appendix C) with the two methods was also evaluated. There were 12,224 dwelling addresses on the "ideal file" and 581 dwelling addresses (4.7%) did not have the dwelling type codes for both methods. The dwelling addresses for which both the dwelling type codes (i.e., AR and VR codes) were present were cross-tabulated. Let n_{ij}

be the number of dwelling addresses with dwelling type code "i" from the AR and dwelling type code "j" from the VR.

Let

$$p_{ij} = \frac{n_{ij}}{\sum_i \sum_j n_{ij}}$$

Then we define Global Gross Difference Rate (GGDR) as:

$$GGDR = 100 \times \sum_i \sum_{j \neq i} p_{ij}$$

$$= 100 \times (1 - \sum_i P_{ii})$$

and Global Inconsistency Index (GII) as:

$$GII = \frac{100 \times (1 - \sum_i p_{ii})}{(1 - \sum_i p_{i.} p_{.i})}$$

$$= \frac{GGDR}{(1 - \sum_i p_{i.} p_{.i})} \quad ,$$

where

$$p_{i.} = \sum_j p_{ij} \quad , \quad p_{.j} = \sum_i p_{ij} \quad .$$

The value of Global Gross Difference Rate (GGDR) lies between 0% and 100%, and that of Global Inconsistency Index (GII) lies between 0% and 200%. A value of zero for GGDR, and hence for GII, implies that the two methods assign identical dwelling type codes. Based on the 9 categories of dwelling types (Appendix C), the value for GGDR was 4.9% and it was 6.2% for GII. An index (GII) value less than 20% indicates good quality (Thibault; 1994). Therefore, we can conclude that the dwelling type codes assigned by the two methods are of good quality.

5. TIME AND COST STUDY

In order to get cost estimates of the field operations, a special Time and Cost Study was also conducted with the field test. The main objective of the Time and Cost Study was to collect cost information such

as time spent and kilometres travelled for each operation performed by the enumerators and the supervisors. A similar Time and Cost Study was also conducted by Lemaître (1983) in the context of the post 81' censal redesign of the Canadian Labour Force Survey.

Relevant cost information for each operation was collected in the field using specially designed forms for the Field Test, and also using the Project Report/Claim forms (F-85) used for the pay system. For various reasons, data collected with the customized forms were not entirely satisfactory. In fact, some information was either not completed or completed incorrectly by the enumerators and the crew leaders. However, by combining information collected on the Project Report/Claim form (F-85) with that on the customized forms, it was possible to produce accurate cost estimates for most of the operations of the Field Test.

Table (5.1) gives the average time spent and kilometres travelled per EA by crew leaders to perform each of their operations in the field. It can be observed that there was no significant difference in the time spent by crew leaders. The crew leaders spent on average 4.1 hours per EA for the AR Updating operations compared with 4.0 hours for the VR Listing operations. It should be noted that the crew leaders received 8.5 hours of training at the beginning of their assignment which is not included in these costs. In addition, the crew leaders also spent 8.0 hours training the enumerators in the field procedures for AR updating and VR listing, and also training for reconciliation and follow-up operations. These training costs for the crew leaders and the enumerators are not included either. It should be pointed out that Preparation includes familiarization with the area, visit to the high-rise apartment buildings and performing the advanced listing and the advanced AR updating for QC procedures.

Table (5.1): Averaged Time Spent and Kms Travelled per EA by Crew Leader Operation

	Preparation		AR Updating		VR Listing		Reconciliation and Follow-up	
	Time (hrs)	Km	Time (hrs)	Km	Time (hrs)	Km	Time (hrs)	Km
EA Average	3.1	20	4.1	28	4.0	29	2.5	17

As described in Section (3) enumerators performed several operations in the field. Table (5.2) gives the time spent per 100 dwelling addresses to: (i) update the AR, and (ii) create VR listings. The same table also gives the time spent per 100 dwelling addresses by method and contact and also include the travel time to the EA.

Table (5.2): Time in hours per 100 addresses by Method and Contact

	Contact	No Contact	Overall
AR Updating	4.3	2.7	3.5
VR Listing	4.4	3.4	3.8

We notice from the above table that without contact the time spent per 100 dwellings for the AR method is about 20% less than that for the VR method. On the other hand, with the contact the time spent per 100 dwellings for the two methods is almost the same. The reason for no difference in the time spent for the two methods with contact is that the enumerators can write the dwelling address in the VR booklet when attempting contact. In addition, the enumerators travelled on average 111 kilometres per EA for the AR updating method and 109 kilometres per EA for the VR listing method.

As far as reconciliation and follow-up are concerned, after receiving 1.5 hours of training, enumerators spent on average 3.5 hours to compare the addresses on the two lists for each EA. They also spent on average 4.4 hours to do the field follow-up for each EA. They travelled on average 67 Kms per EA to perform the Reconciliation and Follow-up tasks which includes the time to come to the Head Office to do the manual comparisons between the two lists.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the field test, we can conclude that the improved VR method using the AR has better coverage than both the AR updating and the VR listing methods. The improvement in the coverage is much better as compared with that obtained during the 1991 Census. This could possibly be due to the improvements made to the AR prior to the field test such as lower undercoverage and improved quality of geocoding of addresses. We feel that the improved VR method using the AR should be further tested in a large scale field test before it can be recommended for implementation. Moreover, the cost aspect of the method will have to evaluated.

Between the other two methods, it was observed that the AR updating method has better coverage than that of the VR listing method. The AR updating method had a dwelling undercoverage rate of 1.5% as compared with 3.1% for the VR listing method. Similarly, the dwelling overcoverage rate for the AR updating method was 0.4% as compared with 2.2% for the VR listing method. For each method, attempting to contact the householder had a positive impact on the coverage for most of the dwelling types. In particular, there was significant improvement for the VR listing method in the coverage for the category "apartment in a building with less than 5 storeys" where dwelling undercoverage and overcoverage rates (8.3% and 2.8% respectively) decreased by almost half when contact was attempted at every dwelling. As far as time spent to perform these operations is concerned, it was observed that it

takes 18 minutes less on average to update 100 addresses in the AR than to list 100 addresses in the VR booklet. These results are based on the comparison between the two methods when contact was attempted for half of the EAs with each method.

Thus it is recommended to use the AR updating method in the street network file (SNF) areas because an AR is available for these areas. The AR method has demonstrated to have better coverage while costing less. We would also recommend applying differential contact rates by dwelling type when resources for 100% contact are not available. Moreover, the respondent burden will be reduced without having any significant impact on the coverage with differential contact rates. In particular, for the category "apartment in a building with 5 or more storeys" only one contact for the apartment building will be sufficient. Single detached dwellings could also be contacted at a lower rate since the undercoverage and overcoverage rates are already quite low for this category. The apartments in buildings with less than 5 storeys should be contacted at a higher rate to improve coverage for this category.

The quality of the EA maps was considered less than optimal, mainly due to the fact that photocopies of the 1991 Census maps were used. It is recommended that new maps should be drafted for any future test (and the 1996 Census) by incorporating the latest available updates.

For the Quality Control procedures, the advance listing (updating) operations and the comparison with the enumerator's work should be done by different persons, e.g., QC technician and the crew leader. The risk of not being able to detect errors would be reduced due to independent review of the enumerator's work.

Additional recommendations are contained in the "Summary of Enumerator Debriefing" in Appendix (D). A detailed report on enumerator debriefing has also been prepared by Hall (1993).

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REFERENCES

BÉLAND, Y. (1993a). "Sampled EAs for the Field Test for Census Collection", internal memo, SSMD, Statistics Canada.

BÉLAND, Y. (1993b). "Spécifications pour le Plan AQ lors de l'Essai sur le Terrain - 1ère Méthode", internal memo, SSMD, Statistics Canada.

BÉLAND, Y. (1993c). "Spécifications pour le Plan AQ lors de l'Essai sur le Terrain - 2ième Méthode", internal memo, SSMD, Statistics Canada.

HALL, M., (1993). "Debriefing of Enumerators for AR Test", internal memo, SOD, Statistics Canada.

HICKS, D., CHOUDHRY, G.H., FAGUY, R., ROBERTS, K. and ZELENBABA, M. (1993). "Centralized Edit Feasibility Study", internal report, Statistics Canada.

LEMAÎTRE, G. (1983). "Results from the Time and Cost Study", internal report, SSMD, Statistics Canada.

SWAIN, L., DREW, J.D., LAFRANCE, B. and LANCE, K. (1992). "The Creation of a Residential Address Register for Coverage Improvement in the 1991 Canadian Census", *Survey Methodology*, Vol. 18, No. 1, pp. 127-141.

THIBAULT, C. (1994). "Étude du Contenu du Recensement de 1991 selon l'Étude de la Contre-vérification des dossiers", internal report, SSMD, Statistics Canada.

APPENDIX A: SAMPLED EAs FOR THE FIELD TEST.

Pedea	CD	CSD	EA Dtype	# of Dwellings by dwel. type				
				1	2	3	4	Total
24015165	81	015	1	230	0	164	2	396
24015154	81	015	2	81	246	42	15	384
24015158	81	015	3	38	0	340	7	385
24015153	81	015	4	106	1	153	155	415
24025454	81	025	1	402	17	42	59	520
24025458	81	025	2	68	230	22	74	394
24025461	81	025	3	1	0	317	15	333
24025459	81	025	4	51	27	57	138	273
35010273	06	006	1	245	0	0	82	327
35010338	06	006	2	3	292	27	75	397
35010324	06	006	3	1	0	317	77	395
35010334	06	006	4	0	1	4	372	377
35050112	06	012	1	244	119	26	0	389
35050113	06	012	2	0	250	109	23	382
35050203	06	012	3	3	0	287	96	386
35050201	06	012	4	1	1	122	252	376
35058561	06	014	1	118	94	38	103	353
35058557	06	014	2	101	156	57	59	373
35058558	06	014	3	98	3	179	135	415
35058560	06	014	4	74	2	112	186	374
35060105	06	014	1	209	103	30	37	379
35060106	06	014	2	110	215	20	33	378
35060060	06	014	3	19	4	180	92	295
35060118	06	014	4	41	61	43	175	320
35061206	06	014	1	246	4	93	67	410
35061164	06	014	2	21	310	51	0	382
35061152	06	014	3	0	2	341	13	356
35061159	06	014	4	30	0	176	206	412
35059413	06	014	1	239	5	3	92	339
35059102	06	014	2	0	162	73	139	374
35059105	06	014	3	0	1	186	66	253
35059103	06	014	4	0	2	70	318	390

EA dominant dwelling type (Dtype): 1: Apt. < 5 storeys; 2: Apt. > = 5 storeys; 3: Single detached; 4: Other

APPENDIX B: DWELLING STATUS CODES

Valid Private Dwelling - Code A. A valid private dwelling represents a dwelling which meets the definition of a private dwelling and is not represented by codes B through E below. A private dwelling is defined as a separate set of living quarters with a private entrance either from outside or from a common hall, lobby, vestibule or stairway inside the building.The entrance to the dwelling must be one that can be used without passing through the living quarters of someone else. A private dwelling also meets all three of the conditions necessary for year-round occupancy: a source of heat or power, year-round access to drinking water and shelter from the elements.

Marginal Dwelling - Code B. Marginal dwelling is a private dwelling which, because it was not built, maintained or converted for year-round use, does not meet all three of the conditions necessary for year-round occupancy: a source of heat or power, year-round access to drinking water and shelter from the elements.

Dwelling Under Construction - Code C. Dwelling under construction is a new dwelling which, because it is not yet complete, does not meet all three of the conditions necessary for year-round occupancy: a source of heat or power, year-round access to drinking water and shelter from the elements.

Dwelling Under Renovation or Conversion - Code D. Dwelling under renovation or conversion is a dwelling which, because it is undergoing extensive renovation or conversion work, does not meet all three of the conditions necessary for year-round occupancy: a source of heat or power, year-round access to drinking water and shelter from the elements.

Collective Dwelling - Code E. Collective dwelling is a dwelling of a commercial, institutional or communal nature. It may be identified by a sign on the premises or by speaking with the person in charge. Examples of collective dwellings include lodging- or rooming-houses, hotels, motels, tourist homes, nursing homes, hospitals, work camps, jails, group homes, and so on.

Address does not Exist - Code F. The address could be of a dwelling that does not exist anymore, e.g. demolished dwelling.

Non-residential Dwelling - Code G. The address represents a non-residential dwelling, e.g. a corner store, an industrial warehouse with no dwelling within the structure, etc.

Duplicate Address - Code H. This is a valid dwelling address which appears more than once in the register.

Address is Outside EA Boundary - Code I. The address is of a dwelling which is not within the EA boundary.

APPENDIX C: DWELLING TYPE CODES

Single-detached - Code 1. A single dwelling not attached to any other dwelling or structure (except its own garage or shed). A single-detached house has open space on all sides, and has no dwellings either above or below it.

Semi-detached - Code 2. One of two dwellings attached side by side (or back to front) to each other, but not to any other dwelling or structure (except its own garage or shed). A semi-detached dwelling has no dwellings either above it or below it and the two units have open space on all sides.

Row House - Code 3. One of the three or more dwellings joined side by side (or occasionally side to back), such as a town house or garden home, but not having any other dwellings either above or below.

Apartment or Flat in a Detached Duplex - Code 4. One of two dwellings, located one above the other, but not attached to any other dwelling or structure (except its own garage or shed). The two units together have no other dwellings attached to the back, front, or sides, and have open space on all sides.

Apartment in a High-rise (5 or more storeys) Building - Code 5. A dwelling unit in a high-rise building which has five or more storeys.

Apartment in a Lowrise (less than 5 storeys) Building - Code 6. A dwelling unit attached to other dwelling units, commercial units or other non-residential space in a building that has fewer than five storeys.

Other single Attached House - Code 7. A single dwelling that is attached to another building and that does not fall into any of the other categories, such as a single dwelling attached to a non-residential structure (e.g., store or church) or occasionally to another residential structure (e.g. apartment building).

Mobile Home - Code 8. A single dwelling designed and constructed to be transported on its own chassis, and capable of being moved to a new location on short notice.

Other Movable Dwelling - Code 9. A single dwelling other than a mobile home, used as a place of residence, but capable of being moved on short notice such as tent, recreational vehicle, travel trailer or houseboat.

APPENDIX D: SUMMARY OF ENUMERATOR DEBRIEFING

Each enumerator was asked to complete an evaluation questionnaire at the end of the Test (Hall; 1993). Out of the 32 enumerators, 31 completed questionnaires were returned. The following is a summary of enumerator debriefing.

- 94% of enumerators felt that the training was adequate to do their job.
- Enumerators would have liked to receive the training material before the training so that they could have read it before the training.
- 87% of enumerators thought that the exercises in the self-instruction program were useful in preparing them code the dwelling type and the dwelling status.
- It was not clear to all the enumerators that contact had to attempted at all dwellings during the first week.
- 84% of enumerators thought that the procedures manuals were very good or excellent.
- 90% of enumerators had no problems in assigning the dwelling status and the dwelling type codes.
- 59% of enumerators had the opinion that updating the AR was easier than listing the VR.
- 50% of enumerators had the opinion that updating the AR was the most thorough and accurate method.
- All of the crew leaders thought that better quality maps would make the enumerators job much easier in particular the symbol to indicate north was problematic.