

THE FIRST YEAR OF COMPUTER-ASSISTED INTERVIEWING FOR THE CANADIAN LABOUR FORCE SURVEY

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As part of its decennial redesign, the Canadian Labour Force Survey (LFS) has recently undergone a major technological changeover. Computer-Assisted Interviewing (CAI) is now the new data collection method. Since November 1993, the CAI mode has been gradually introduced in the LFS. Within a few months, portable computers (notebooks) replaced the traditional Paper And Pencil Interviewing (PAPI). This paper describes the major impact of this important change on some data quality indicators as well as the challenges encountered during the implementation. It also discusses the introduction of new types of quality indicators which are now available with the implementation of CAI.

This paper is divided into four sections. The first section briefly describes the Canadian Labour Force Survey. The second section discusses the conversion strategy from PAPI to CAI. The third section analyses current and new data quality indicators. The current data quality indicators are measures which are regularly produced such as nonresponse rates and edit failure rates. New data quality indicators can be divided into two types. There are those which were produced since the introduction of CAI to monitor and measure the performance of CAI. As well, there are the quality indicators from the case management system of CAI which provide previously unavailable information about the interview process, such as the average duration of the interview and the number of calls required to contact the respondent. The last section outlines the lessons learned and the future of CAI for the LFS.

1. The Canadian Labour Force Survey: An Overview of the Survey

The LFS is a monthly household survey conducted by Statistics Canada to produce estimates of labour force characteristics of the Canadian population, such as employment and unemployment at national and provincial levels, as well as by industry and occupation. The LFS uses a stratified multi-stage sampling plan with the dwelling as the final sampling unit. The sample is split into six representative sub-samples or panels, and each month the dwellings from one of the panels (one-sixth of the sample) are replaced. Selected dwellings remain in the survey for six consecutive months. Approximately 55,000 households, representing about 110,000 individuals, are in the sample

each month (see Singh et al., 1990).

Statistics Canada's six Regional Offices (RO) employ 950 interviewers to conduct interviews. The first (or birth) interview with the household in the dwelling is conducted in person by an interviewer. Subsequent interviews are conducted by telephone. Prior to November 1993, all interview results were captured by paper and pencil and subsequently entered into minicomputers at the RO.

2. Conversion Strategy : from PAPI to CAI

Even though the implementation of CAI implied complex reorganization and fundamental restructuring of survey processes, there were advantages to converting: (i) improvement in data quality (basically through on-line editing done directly with the respondent and elimination of human errors such as in not following skip and branching patterns in questionnaires); (ii) faster data processing (data capture is now done by the interviewer at the time of the interview); (iii) long-term cost benefits (due to combining the data capture steps); (iv) development of a generalized data collection tool and; (v) the possibility of handling more complex questionnaires (internal programming of all questionnaire skip and branching patterns into the notebook lets it automatically display the next relevant question).

One of the first major impacts of CAI will take place in 1997, when a new questionnaire will be introduced. This questionnaire will be much more complex than would have been possible with PAPI.

Before actually implementing CAI, there were several years of evaluation and testing. Since the late 1980's, the LFS has undergone three major tests. The principal objectives of the first two tests were: to test the potential of CAI (Catlin and Ingram, 1988) and to test the feasibility of using new technologies in the LFS (Kaushal and Laniel, 1993). The third test, called the Data Quality Test (Kaushal and Laniel, 1995), was primarily aimed at evaluating the impact of the change on the continuity of LFS series and on data quality. On the basis of all findings, it was decided to convert the mode of the data collection to CAI in the fall of 1993.

The strategy adopted was to gradually introduce CAI as the new collection method. This was done with three important goals: (i) to avoid disruption in the historical series, (ii) to minimize the introduction of any collection mode bias and (iii) to minimize the massive change in the interviewer work procedure and in the data collection process. The strategy was to convert at random a third of the interviewers from PAPI to CAI, in all ROs in November

1993, another third in December 1993, maintain the status quo in January and February 1994 and finally to convert the remaining third in March 1994. There were two reasons for the status quo period: (i) to allow an adaptation period for adjustment and problem-solving and (ii) operational constraints. In January and February 1994, two new longitudinal surveys, which also required the use of the notebooks, were introduced.

As part of the conversion strategy, when an interviewer was converted to CAI, his or her whole assignment had to be completed with CAI and that interviewer continued with the computer-assisted method. All of the data collected with CAI were used in the production of LFS estimates. Paper and pencil interviewing was available as a contingency for all interviews which could not be completed by CAI, for operational reasons. The PAPI backup option is in place until January 1997 when the new questionnaire is effective.

3. The impact of CAI on data quality indicators

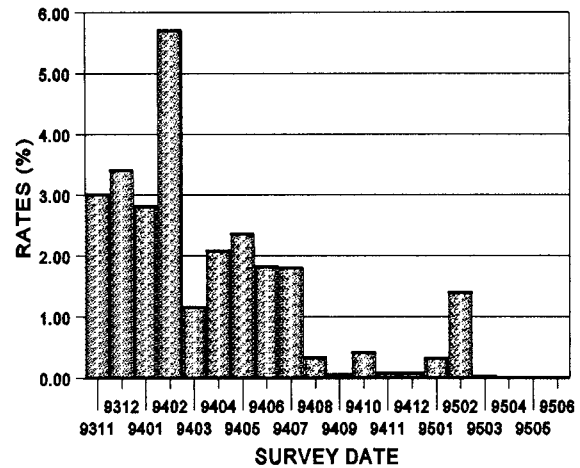
In this section, both current and new data quality indicators (DQI) are analysed. The current DQI include some of the regular indicators which are produced and monitored monthly by the LFS Data Quality Committee (DQC), namely: nonresponse rates and edit failure rates. There are two types of new DQI: those which measure the performance of CAI (the conversion rate and the technical problem or "Z code") and those which are now available from the Case Management System (CMS). This system manages all the survey activities from the beginning to the end of the survey cycle.

3.1 New data quality indicators : Evaluation of the performance of CAI

There are two indicators that are closely followed by the DQC to measure the effectiveness and efficiency of CAI. One of these is the conversion rate and the other is the technical problems or "Z" nonresponse codes. Figure 1 shows the conversion rates from CAI to PAPI since November 1993. During the interview, interviewers who were not able to complete an interview with CAI, for any reason, could pursue the interview with PAPI. The portion of interviews that should have been conducted with CAI but were converted to PAPI is reflected by the conversion rate. Ideally, there should be no conversion. The conversion rates varied between 1.0% and 5.7% from November 1993 to July 1994 with an average of 2.6% per month. From August 1994 until now, the conversion rates are always less than 0.5%, except for the February 1995 survey (1.3%). This high rate coincides with a communication failure, which occurred in one of the ROs, and was responsible for 99% of all cases converted in February. Since March 1995, the conversion rates have been zero. Consequently,

it took about a year for the conversion rate to stabilize and to reach a satisfactory level.

Figure 1: Conversion Rates in the Field : From CAI to PAPI

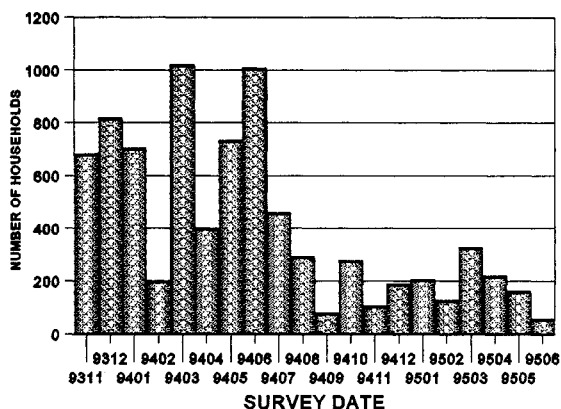


As for the second indicator, technical problems, the important occurrence of "Z's" is a result of the use of new technology and was most unpredictable. Since the introduction of CAI, "Z" codes have become more frequent. Although this code already existed previously, the definition has changed somewhat. "Z" nonresponse codes have been and are still defined as "too late for processing". Before CAI, they reflected a postal problem. Since the introduction of CAI, they are a reflection of technical problems, such as transmission problems, disruptions of telephone lines, uploading data processing system failures, automatic computer maintenance function which disconnects all transmissions without warning, etc. There were also hardware problems such as: hard disk failures, magnetic tape failures, insufficient memory allocations, etc. All these problems were resolved case by case, requiring time and resources during the survey cycle. Since all LFS operations have a very tight schedule, sometimes there was not enough time for those late records to be processed for the current surveys.

As shown in Figure 2, the number of technical problems has decreased since the fall of 1994. This decrease coincides with a new version of the CAI application, which is largely responsible for this improvement. Similar to the conversion rate, it took about a year of CAI to observe an improvement in the "Z" codes. Prior to the introduction of CAI in November 1993, the "Z" code was almost zero. From November 1993 to August 1994, the average was 600 cases per month, dropping to an average of 170 cases since August 1994. It has stabilized around 0.3% in recent surveys (see section 3.2).

These two indicators are used to assess the performance of CAI. Both measures showed relatively high rates and numbers at the beginning of the implementation of CAI.

Figure 2 : Z Nonresponse : Number of Technical Problems



Recently, especially after August 1994, both have stabilized and are at satisfactory levels. The CAI system will attain the desired level of performance when both measures become close to zero.

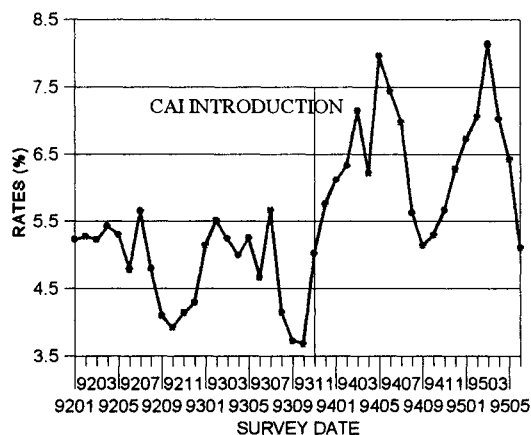
Regular Data Quality Indicators

Nonresponse Rates

During the four-month implementation period, from November 1993 to February 1994, both collection methods were used simultaneously. During those four months, nonresponse rates were systematically higher for the sample interviewed with CAI than with PAPI. (For a more complete look at this four-month implementation period see Simard and Dufour, 1995). There is a major difference between the nonresponse rate before the introduction of CAI and since then. Figure 3 shows the total nonresponse rate for Canada since January 1992.

Historically, LFS nonresponse rates average around 5% at the national level. During the first year of CAI, the nonresponse was generally higher than this. The

Figure 3: LFS Nonresponse Rates



nonresponse rate reached a maximum of 8.1% before dropping again and then returning to its usual range of 5%. Since the introduction of CAI, seasonal trends, which used to be present during the year, have been disturbed slightly.

Another complicating factor is the new sample design which was introduced gradually over a six-month period starting in October 1994, as part of the major decennial redesign of the LFS. This fact has two features which affect nonresponse rates. One of the new characteristics of this sample design is the greater proportion of urban to rural sample than the previous design. This fact does influence this analysis since it is well known that nonresponse is higher in urban areas than in rural areas. The other feature is the related hiring of a number of new interviewers, who generally have higher nonresponse rates than experienced interviewers (defined as 6 months and over of experience with LFS), as observed in Figure 4. Therefore, one of the factors in the increase in nonresponse after October 1994 can be explained by the introduction of the new sample design.

Figure 4: LFS Interviewer Nonresponse Rates by Length of Experience

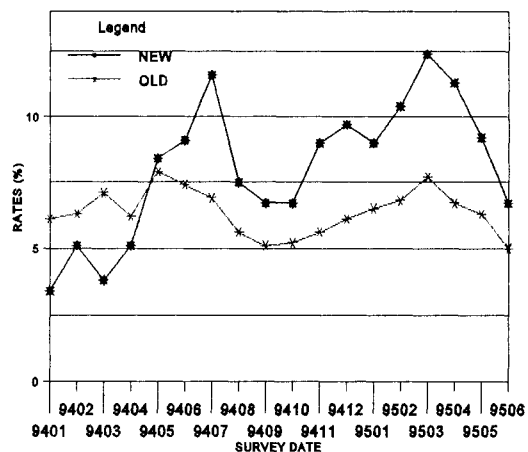


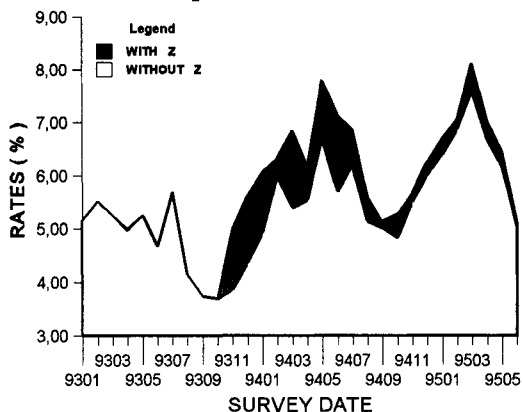
Figure 5 presents the effect of "Z" codes on nonresponse. Technical problems are the main cause of the increase in total nonresponse rates. After subtracting the portion of nonresponse due to "Z's" from the total nonresponse, the curve shows trends similar to the previous year.

During the four-month implementation period, the "Z" codes were the sole cause of higher nonresponse rate for CAI. After removing them, the average nonresponse rate was almost the same for CAI as PAPI (4.9% vs. 4.7%).

Nonresponse Rates by Reason

Nonresponse has several causes. Before the implementation of CAI, the total nonresponse rate was mostly a function of "Temporarily absent", "No one at home" and "Refusal"; "Technical problems" had no role.

Figure 5: Impact of Technical Problems on Nonresponse

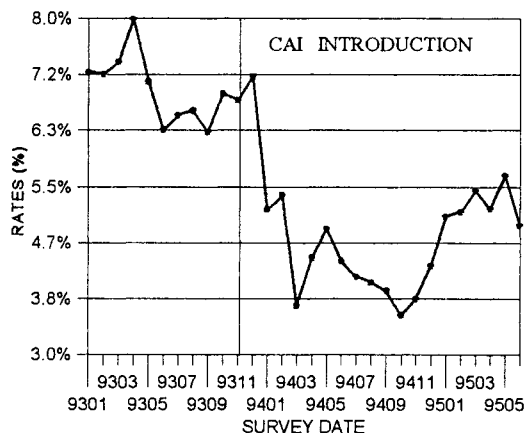


However, with CAI, the total nonresponse rate is dominated by "Technical problems" and is influenced very little by the other components. Regional Operations managers were originally concerned about refusals. Many felt that respondents would be more reluctant to respond because of privacy concerns around the use of a computer. This has not occurred; the refusal rate has not shown any major change since the implementation.

Edit Failure Rates

One of the expected benefits of using CAI is the improvement in data quality. Using CAI as the new data collection method should eliminate two potential sources of error in the LFS. One source that should be eliminated is questionnaire flow errors, because the application of CAI establishes the correct path and the appropriate subsequent questions. Secondly, a number of on-line edit rules enable the system to detect errors and allows corrections by resolving with the respondents any discrepancies during the interview. These two features are well-liked by the interviewers and facilitate their work. Figure 6 presents the national edit failure rate which represents the proportion of forms (questionnaires) which contains at least one

Figure 6: LFS Edit Failure Rates



discrepancy.

As observed in Figure 6, the improvement in the edit failure rates was immediate. As soon as the CAI mode was introduced, the rate decreased considerably, even though only a portion of the total number of questionnaires were completed with CAI from November 1993 to March 1994. When the full implementation was completed in March 1994, the rate reached a minimum of 3.8%. The minor increase after October 1994 can be related to hiring new interviewers. As they gained experience, the rate decreased, which happened about 6 months later as observed in the April 1995 survey. The increase observed since October 1994 has never reached the level before the implementation of CAI. This indicator shows that the introduction of CAI was beneficial for the LFS data quality.

3.3 The New Data From the Case Management System

All computerized survey activities are managed by a sophisticated data management system called the Case Management System (CMS). This system is used by most household surveys at Statistics Canada which use CAI. The CMS records everything that is done for a particular case for all interviewers and interviews. As soon as something is keyed into the computer, a file is created which records the history of the case including the day and time of the occurrence. The main functions of Case Management are: routing, reporting, and providing assistance to the interviewer during the progress of the survey. From this system, new information can now be gathered and analysed. Such information includes: the best time and best day of the survey week to complete an interview, the average duration of interview and the average number of attempts before contacting the respondent.

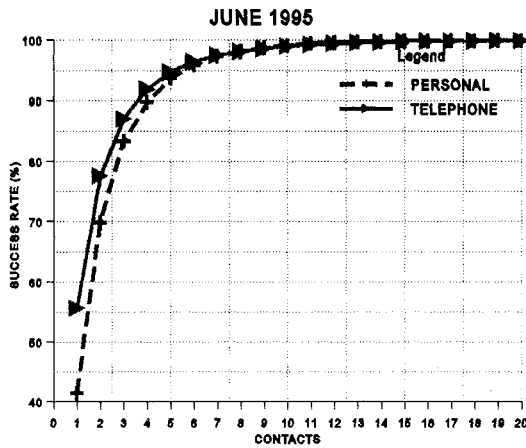
The new information allows more to be known about the interviewer's work. The interviewer's work schedule, how the interview was completed, the on-line editing and what errors happened during the interview are all things that can now be monitored.

All of these new data can be presented by geographic breakdowns or other variables of interest. A research team has been built to develop new DQI and to find efficient uses for them. These new indicators will provide information for more efficient management of the survey. The CMS also provides quantitative data easy to process on every aspect of the interview, from the time and number of attempts to on-line editing. The new data can also be used to improve the interviewer's training and to reinforce good behaviour such as better assignment planning and scheduling. Figures 7 to 10 show the type of new information available from the CMS for the June 1995 Survey.

Figure 7 shows the number of attempts before completing an interview either by telephone or in person. A time-cost

analysis could be conducted with these data. The curve

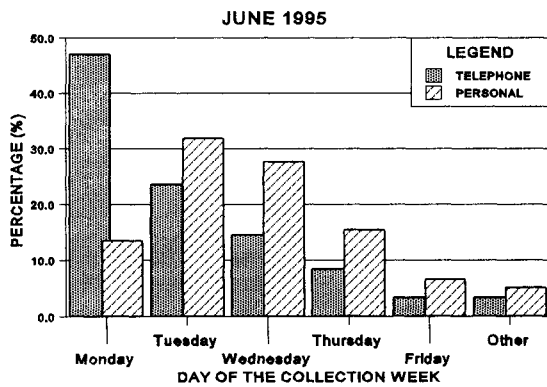
Figure 7: Number of Attempts Before Interviewing the Respondent: Personal vs. Telephone Interviews



shows that after 6 attempts to contact a household, the probability of reaching the respondent does not increase considerably. The success rate is about 95% after 6 attempts for both types of interviews and the curves remain stationary after this point.

Figure 8 shows the distribution of interview day. 50% of all telephone interviews (roughly 22,000 households) are completed on the first day of the collection period (Monday). On the other hand, most of the personal interviews are completed on Tuesday (31%) and Wednesday (28%).

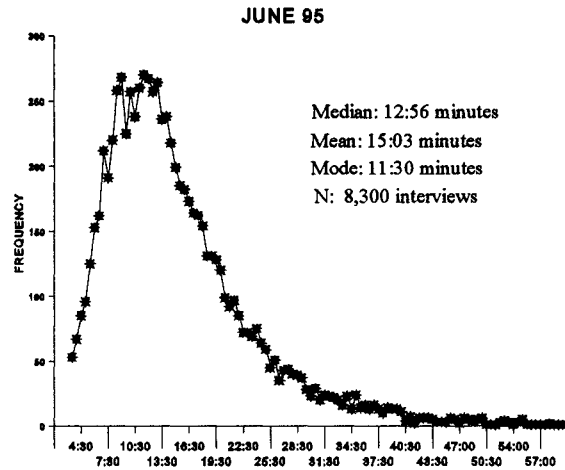
Figure 8: Distribution of Interview Day: Personal vs. Telephone Interviews



Another piece of information provided by the CMS is the most successful combination of time and day interval to complete an interview. For the birth sample (personal interviews), the best time and day to interview is Wednesday night between 6 and 8 pm, mainly during dinner time. As for the subsequent months (telephone interviews),

the best combination of time and day are: Monday between 10 am and noon and Monday between 6 and 8 pm.

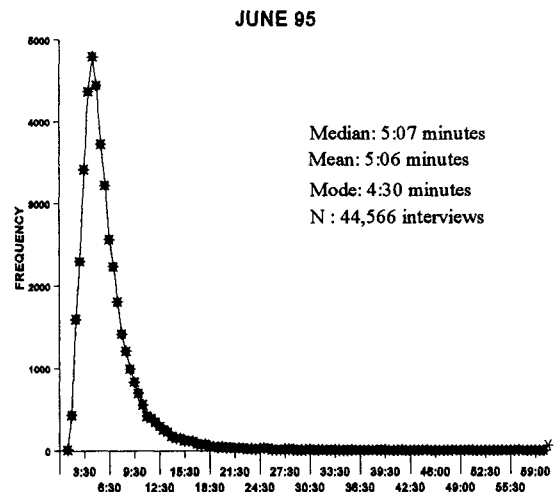
Figure 9: Distribution of Duration of Personal Interviews



Figures 9 and 10 show the distribution of duration of both type of interviews. The average length of the personal interview per household is about 15 minutes and the mode is 11 minutes and 30 seconds. As for the telephone interviews, the average length is roughly 5 minutes and the mode is 4 minutes 30 seconds.

All this new information will be used to develop new DQI which will assess and evaluate the performance of the new interviewing system, the interviewers' work as well as the data quality itself.

Figure 10: Distribution of Duration of Telephone Interviews



4. Lessons Learned and Future Work

The LFS has completed a massive data collection redesign which involved the entire survey processing system and resources. During any major change, especially involving new technology, a period of adaptation must be expected. There is a normal learning curve for everybody involved in the process. The implementation of the new data collection method for the LFS is no exception. For the LFS, this period lasted about a year. During this time, continuous improvements were made to the system to solve encountered problems.

There are three major lessons learned in the conversion of the LFS to CAI. First, communication is essential since the information has to flow between all the staff involved. Second, training is crucial, especially at the interviewer level. They have to face two challenges: new technology and new working procedures. The interviewers, hesitant at the beginning, now generally prefer to work with CAI than with PAPI. The flexibility, the professionalism and the on-line editing are features well-liked by them.

Finally, expect the unexpected by developing contingency plans. Even though testing was done, the testing environment is never the same as the production environment, and as problems arose, people had to react quickly. For the first year, the RO field managers were simply reacting to problems as they came up. There was no time to prepare for future problems in advance. Recently, the situation has improved greatly with the stabilization of the technical problems and the conversion rates. The continuous improvement done to the CAI system is mainly responsible for this stabilization.

The LFS is now adjusted to its new data collection method and the data quality indicators are reverting to their traditional levels. Conversion and technical problems are becoming minimal. The LFS is now at a stage where CAI is working more or less as hoped.

As for the future of CAI as a data collection method, it is very promising. As the technology is continuously improving; faster, more efficient and more effective application are being developed and implemented. New versions of the CMS and the CAI applications are expected in 1996. A research team is now looking at all those newly available data from the CMS. The main challenges of this team will be to develop new DQI for the entire survey process and to find the best way to communicate the information back to the ROs.

A new LFS questionnaire (more complex and longer) will be implemented in 1997. This is a direct impact of using CAI. Given the complexity of the questionnaire, it would not have been possible with PAPI.

In conclusion, as challenging as the implementation of CAI was, there are more advantages than disadvantages of

using computer-assisted interviewing. The flexibility of the instrument and the ever advancing technology provides possibilities for more efficiencies.

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