

T.M. Cottrell-Boyd, M.R. Dunn, G.E. Hunter, K.P. Srinath, Statistics Canada

INTRODUCTION

In 1976, Statistics Canada embarked on a revision of its establishment-based employment and payroll program. An interdepartmental team, the Program Objectives Team, defined the conceptual framework of a survey redesign within which user needs could be met. Subsequently, a senior team, the Design Specifications Team, comprising only Statistics Canada personnel determined guidelines for the redesign strategy within this conceptual framework. On completion of their deliberations, the Project Implementation Team was established to implement this framework through a comprehensive design and development program involving a sequence of field tests, investigations into the use of administrative data and extensive general research into concepts and methods.

It is intended that this paper provide a summary of how this multi-phase program is developing into the final survey system to be put in place in 1981, and of the statistical methodology designed to date.

BACKGROUND

Statistics Canada has been collecting and publishing data on employment since about 1918, although initially data published covered only certain industries and those employers with more than fifteen employees. In 1941, as a result of the need for measurement of the intensity of the World War II effort, Statistics Canada was instructed to undertake the collection of statistics on earnings. In 1961, the survey was extended to include a sample of small employers and in 1968 employment data were collected from governments, hospitals and educational, religious and welfare institutions (the so-called GAP area) for the first time. The employment surveys are in fact three separate monthly surveys: the ES1 survey collects employment together with wage and salary data for all firms with twenty or more employees, the ES2 survey collects employment only from firms with less than twenty employees and the GAP survey collects primarily employment data.

The problems associated with operating three separate survey processes together with the identification of a large number of specific survey problems including both conceptual and definitional problems led Statistics Canada management to consider a complete redevelopment of the employment survey. Additionally the cost of the survey process in terms of response burden especially inasmuch as the ES1 is a census, and certain difficulties experienced in the provision of labour income data in the mid-1970's were clearly recognized by management as problems for which solutions were needed.

However, rather than deciding to develop a makeshift solution to these problems, management opted to develop a new survey system based on

- (i) a complete review of survey objectives
- (ii) an evaluation and investigation of alternative survey techniques and methods, and
- (iii) an extensive field testing program.

With these intentions bureau management commenced a review of the employment and payroll statistics program under the umbrella of the Employment Statistics Development Project (ESDP).¹

THE PROGRAM OBJECTIVES TEAM (POT)^[2]

As a preliminary step, a series of background papers were prepared on the current surveys by the bureau and circulated to users. It was suggested that users make submissions on the problems that they had encountered in using the statistics from the surveys. The resulting submissions became the starting point for identifying changes needed to the surveys.

These user needs can be roughly summarized as follows:

- i) a requirement for timely and reliable monthly data within broad geographic and industrial classifications to meet the needs of users involved in current economic analysis and forecasting
- ii) a requirement for more detailed information by industry at a sub-provincial level on an annual basis, and
- iii) a requirement to provide detailed labour information at a micro data level for use in economic censuses in order to avoid duplication of collection of data.

The need for one employment and earnings program designed to cover all industries and sizes of establishment was judged to be essential.

The six basic elements of the proposed redesign process recommended by this team were as follows:

(1) Survey Vehicles

- a monthly sample survey covering all sizes of businesses and all industries designed to provide reliable estimates of employment trends
- an annual program designed to provide information at a more detailed level of aggregation and to establish reliable estimates of level
- an all-industry survey of labour costs
- a capability to undertake supplementary surveys for special information required by users

(2) Administrative Data

- investigations into the use of data potentially available from the Revenue Canada-Taxation payroll deduction system²

(3) Coverage

- employers in all provincial and territorial areas, in all sizes of business and in all industries excluding hunting, fishing, trapping, agriculture and private households

(4) Timeliness

- preliminary estimates within 25 working days of the reference month
- the monthly publication incorporating final monthly estimates by the third month following the reference month
- annual statistics within six months of the reference year

- (5) Reliability
- a compromise between such factors as response burden, timeliness and cost.
- (6) Comparability
- a comparability between the estimates of the establishment and household-based paid worker series.

Such a developmental program was to take place through 1977-80, since POT specified that a one-year parallel run of the survey was necessary and that the survey must be fully operational in 1981.

THE DESIGN SPECIFICATIONS TEAM (DST)^[3]

Following the completion of the report detailing the objectives, the Design Specifications Team was established. This team translated the general statements in the POT report into a specific program of work. This was accomplished by the listing and review of possible topics of a methodological nature recommended for consideration by the POT report. The following are the major recommendations included in the DST report:

(1) Nature of Monthly Program

DST recommended that the wage and salary totals produced by the T4 system be accepted as the national benchmark for the revised employment program. It recommended that work be carried out to investigate:

- i) the ways and means to disaggregate the national benchmark into subnational industrial and geographic benchmarks
- ii) whether a monthly benchmark could be derived from the PAYDAC system, and
- iii) the methodology of adjusting to benchmarks and deriving the sample size consistent with the benchmark strategy.

(2) Nature of the Annual Program

DST listed four possibilities for the annual program which could be used either alone or in concert:

- i) use of the T4 supplementary data available annually from Revenue Canada-Taxation
- ii) amendment of the Revenue Canada-Taxation PAYDAC collection form, the PD7 form, to collect employment and earnings
- iii) an annual survey - potentially an expansion of the monthly survey in a representative month, and
- iv) a twelve month rollup of monthly data.

(3) Data Collection Strategy

DST recommended that a cost-benefit evaluation package on potential data collection strategies ranging from total centralization to total decentralization to the Regional Offices³ be undertaken to test the following factors: the rate and timeliness of the response, the effect on respondent relations, the potential of telephone interviewing, the quality of the response and the problems of operational control.

(4) Reliability Specifications

DST recommended that a minimum acceptable level of reliability be specified, and that the cost of the survey based on the sample size required by this level should be established during the testing period.

- (5) Compatibility with Labour Force Survey Data
DST suggested that the differences between the labour force survey and the revised employment survey (e.g. due to coverage differences, duplication problems, conceptual differences in one or both series or the effect of the different reference periods) be explainable and quantified whenever possible.

(6) Other Recommendations

DST suggested that a review on a division-by-division basis establish the feasibility and the procedure of transmission of labour data to Economic Census divisions. It also recommended that the multi-establishment firms and all units of the largest business enterprises be surveyed on a regular basis.

DST stipulated that, within reason, no variable or procedure should be incorporated into the final system unless it had been fully tested, evaluated and accepted in terms of its effect on quality, timeliness and cost.

PROJECT TEAM APPROACH

The third-phase team, the Project Implementation Team (PIT), was convened in September of 1977. PIT consists of a project manager and specialists in mathematical statistics, labour economics, data processing, and head office and regional operations. The project manager is a specialist primarily in project management rather than, as is often the case, in the survey subject matter. This enables the project manager to gear progress and decision-making toward the objectives of the project without favouring or being seen to favour any particular discipline.

The first task of PIT was to put together a comprehensive program which would allow for all of the recommendations and objectives specified by POT and DST to be thoroughly researched and tested and would ultimately build into the new survey.

In order to ensure that this research and testing would be accomplished within the required time frame, the project manager set up a number of teams and working groups. Each of these teams consisted of members from the relevant disciplines and was responsible to PIT and to the project manager. The DST has served as a senior review group for PIT.

THE TESTING AND RESEARCH PROGRAM^{[4],[5]}

The investigations into the use of administrative data, the field testing and the survey design will be examined briefly.

Administrative Data

The purpose of the investigations into administrative data was to find a source of labour data of benchmark quality. Two sources of data from Revenue Canada-Taxation (RC-T) were identified by POT and DST to be candidates. The first source, the T4 Supplementary file, carries total annual earnings data for each person as identified by their social insurance number (SIN) and by their employer's PAYroll Deduction Account number (PAYDAC Number). For each calendar year and for each employee all employers send to RC-T not only this earnings data but also data on unemployment insurance (UI) premiums, Canada or Quebec Pension Plan (C/QPP) premiums and income tax deducted.

Hence, this source provides a good coverage of the employment universe. Also, the PAYDAC account can be linked to the business survey frame, the Business Register⁴ (BR), since the PAYDAC file is an integral source of births and deaths for the BR. Hence, personal earnings can be linked to PAYDAC accounts which can be linked to BR businesses, and earnings can then be distributed according to the geographical and industrial coding on the BR. The T4 Supplementary file is therefore a potential annual benchmark for earnings data. The second source was the PD7 form on which employers record the monthly deductions (UI, C/QPP and income tax) that they remit into an RC-T PAYDAC account on behalf of employees. It was thought that Statistics Canada could negotiate with Revenue Canada-Taxation to collect number of employees and wages and salaries on a monthly basis by adding these two questions to the PD7 form. Thus the data from the PD7 form would provide a potential monthly benchmark for employment and earnings.

The investigation into the T4 Supplementary file concluded that there was no reason to believe that tabulations of T4 earnings by current geographical and industrial coding were of benchmark quality. The T4 Supplementary file for a given reference year is made available to Statistics Canada in October of the following year. This means that tax data for 1980 will be available in October 1981. POF and DST required annual estimates within six months of the reference year in order that these estimates be useful for detailed structural analyses by industry at the sub-provincial level. By comparing earnings data on comparable elements from the T4 and current survey sources it was determined that there is reason to believe that such data agree only at the industry division nationally or at the all-industry total provincially. ESDP annual requirements are for a considerably more detailed level of disaggregation. Specifically 41% of the 33,312 companies in the comparison reported earnings in different earnings ranges from the two sources, even with wide earnings ranges. As a result it was decided that there is currently no adequate annual benchmark for the employment surveys.

It was thought that the PD7 form could be an important source of labour data if remittances were made promptly each month and if the PD7 form were amended to collect employment and earnings data. A feasibility study, which had been undertaken by the PD7 team of ESDP in 1977, revealed that earnings and employment data were readily available at the same location as the payroll deductions data required for the PD7 form itself. The cost to Statistics Canada of a quality-controlled monthly data collection and data capture of two questions at Revenue Canada-Taxation and a concern about the respondent burden of adding two questions to the PD7 form led senior management to decide that money to fund a system based on an amended PD7 form could not be made available.

It was felt that deductions could perhaps be used as an auxiliary variable for earnings and that this would result in a substantial decrease in sample size. The investigation revealed several problems with this suggestion. The PAYDAC system is a continuous flow accounting system

which has not been set up to recognize the survey taking concept of reference month, but to maximize its monetary intake. Hence, there are several ways in which deductions are allocated to an incorrect reference month or, in the extreme, appear to be negative. Another problem is that deductions can be based on any combination of tax UI and C/QPP depending on how the employer uses the account. The components need not be reported separately, and even when reported separately, are not data captured. In the investigation the correlations of earnings to deductions were low (about 0.30) for single companies (i.e. survey sampling units) with 0-50 employees; whereas, correlations were 0.66 for single companies with 51-200 employees and 0.92 for single companies with more than 200 employees. Hence, in the small firms where there is the greatest scope for reducing sample size the correlations were the weakest and there would be no gain in efficiency through the use of deductions as an auxiliary variable. Since small businesses remit small dollar values and are followed up less rigorously, there would be some sampling units for which values of the auxiliary variable would not be available. As a result it was generally accepted that it was not possible to develop an administrative data source from the PAYDAC system which would be of benefit to ESDP at this time.

In view of the aforementioned lack of funds and the unsuitability of the administrative data for deriving benchmark totals, it was decided to design a monthly survey for establishing levels rather than trends alone.

Field Testing

The objectives of the field testing program are the reduction of response burden and the improvement of data quality through the design of better questionnaires, the most appropriate wording of questions, the determination of what data are readily available, the collection of data in an appropriate manner (according to how payroll books are kept) and determination of the smallest sample possible to obtain results of prespecified reliability.

A strategy was developed which involved a sequence of tests to deal with the above concerns. A description of each test follows.

(a) Field Test I (January, February 1978)

In the summer of 1977 the Employment Compensation Test was held to provide some basic information for Field Test I on the details that employers maintain in employee compensation records, the terminology that is used and the most efficient methods of requesting data from records. The purpose of Field Test I was to determine if there were specific patterns of data availability by industry and if each data item of interest was available on a monthly and/or annual basis. The criterion for availability was whether the data could be taken easily from records without extra compilation. Some 1300 reporting units of all sizes of employment were interviewed by regional operations staff.

Some examples of findings are that:

- about half of the units interviewed employed part-time personnel, the prevalence of such people increasing with the size of firm.
- Retail trade was the prime user of other than full-time personnel;

- "salaried" and "hourly-rated" were the classifications used most frequently to designate employees;
- 59% of the units reporting employment, wages and hours data could report both hirings and separations and of these about 70% could obtain such data directly from their payroll records. However, it was the smaller firms which were liable to have such turnover data available from payroll records.

It was decided that there is little use in attempting to obtain turnover data on a monthly basis through the employment survey. The questionnaire would need to be sent to another area of the establishment for such information and obtaining the data would slow the completion of the questionnaire.

In order to determine whether industry specific questionnaires should be used, it was necessary to know whether specific payroll characteristics were common to industries or groups of industries. To obtain this information the test data were subjected to non-parametric multivariate clustering techniques. The results indicated that, for many industries, there exists little difference between the payroll reporting structures, and thus a basic questionnaire should be constructed. They suggested also that, in addition to the basic questionnaire, specific questionnaires should be considered for Education and Health; Finance and Insurance; Forestry; Manufacturing (durable); Manufacturing (non-durable).

Further, the test showed that data on employment, wages and salaries by sex are not available readily either monthly or annually and, if requested on the questionnaire, could lead to delay in reporting.

(b) Reference Period Testing

Considerable pressure had been put on the Labour Division both to improve the timeliness of the estimates and to provide employment data which could be better compared with data from the Labour Force Survey. The adoption of a reference period earlier than the last pay period of the month (as in the present survey) had the potential to allow both of these objectives to be met.

Thus a test was held in March, April and May of 1978 to determine if respondents could report timely data for an early pay period of the month, to measure the differences in weekly estimates obtained from the last pay period and to determine if there is consistency from month to month in the magnitude of differences using the early pay period. Any reporting difficulties that the respondent might have with reporting specific questions using the early reference period were to be identified. It was the first test of gathering wage and salary data for ES2 size firms (under 20 employees) and the first attempt at gathering regular employment data by telephone.

The total sample was some 2000 reporting units. Of these, 850 were of ES2 size and 1150 of ES1 size. Regional office staff phoned for information for the pay period containing the tenth of the month (which previous research had shown to be the best early pay period) and, in a later call, the information for the last pay period in the month.

The results of this test showed that:

- about 55% of units would be able to complete the questionnaire around the 15th to the 19th of the month and approximately 95% of units could do so by 20 to 24 days after the 10th;
- 7% of respondents claimed that if an early reference period were adopted there could be some payments that they would not be able to report. Of the seven percent, 46% stated that commissions could not be reported, 28% bonuses, and 17% isolation payments;
- overall, the data suggested that the employment, earnings and hours data reported at the early and late reference periods tend to be similar, if not the same, except for ES1 size units which over all industries, reported slightly more employees, pay and hours for the early reference period;
- in most industries there was strong evidence against the hypothesis that average weekly earnings are the same for all size groups.

This test provided no evidence to support the hypothesis that ES1 and ES2 average weekly earnings are the same. This implied that earnings data should continue to be collected from small firms in future tests and, if thereby further substantiated, in the revised survey.

Earnings data are an important component of labour income which comprises a substantial portion of the GNP. Subsequent research indicated that many special payments which are important in labour income estimates are paid on a monthly basis and might be lost with an early reference period. This plus the desirability of collecting gross monthly payroll for labour income led to the decision that a late reference period be used.

(c) Field Test II

The purposes of this test were firstly to compare the performance of a set of questionnaires tailored to the collection of data appropriate to specific groups of industries to the performance of a general questionnaire in terms of quality, timeliness and cost, and secondly to establish whether the initial survey contact and/or the survey follow-up action should be undertaken from the head office (HO) in Ottawa or from the appropriate regional office (RO). The following table outlines which follow-up methods were used with which initial contacts. It would be possible to assess the effect of a second follow-up by industry and size. A sample of 1096 ES1 size units and 2304 ES2 size units was selected to provide information on all of these concerns.

FIELD TEST II DATA COLLECTION PROCEDURES

<u>Procedure</u>	<u>Point of Mailing</u>	<u>Point of Receipt</u>	<u>1st & 2nd Follow-up</u>
1	HO	HO	HO TEL
2	HO	RO	RO-RO TEL
3	RO	HO	HO-HO TEL
4	RO	RO	RO-RO TEL
5	TEL		TEL

TEL - A telephone interview from appropriate RO

HO-HO is used to mean the mailing and receipt of a reminder questionnaire from head office to head office.

The results of the test can be summarized as follows:

- error rates⁵ for questionnaires completed by telephone were one-half to two-thirds of the error rates for questionnaires returned by mail. Error rates in general increased as size of unit increased;
- for initial collection telephone gave a response rate of about 2.5 times better and an average turnaround⁶ of 11 days faster than any mail collection procedure. For follow-up this advantage was only slightly smaller;
- of the various combinations of mail collection tested, utilizing both regional offices and head office, mail from a regional office and back to the regional office was the best procedure in terms of timeliness by about 1.5 days;
- about 80% of small units (with under 50 employees) required only one phone call when the initial collection method was by telephone. For large units this decreased to about 40%.
- essentially there was little difference between general and specific questionnaires in regard to telephone rates or timeliness. Both had a response rate of about 75% and average turnaround time of about 25 days.
- cost data showed that the per unit cost of obtaining data by telephone was about seven times that of obtaining data by mail. (The ratio was lower for small units.);
- no consistent systematic regional office error effect was found;
- about 22% reported a different number of employees to the ES1 survey than to the Field Test II for the same reference month, 14% reported fewer in the Field Test II while 8% reported fewer in the ES1;
- for all industries, the response rate for overtime questions by mail was consistently higher than the response by telephone. (It was thought that this could be due to the fact that the staff who were asking the questions were the staff used to working with the present survey which does not collect overtime data and that they may have omitted this question for that reason.);
- 2.7% reported casuals on the ES1 but did not report other than full-time on Field Test II.

As a result of this test the following key elements of the data collection strategy and questionnaire design for the final survey were determined.

Since there was no difference in response rates to the general and specific questionnaires and since there is a need for breakdowns of data, groups of industry specific questionnaires will be used.

As noted in the results telephone collection was the most effective procedure of the five types of collection, improving both timeliness and quality. Thus telephone will be utilized to the fullest extent. In order to take advantage of the improvement to quality and response afforded by the telephone and since RO-RO is the best mail collection procedure, the regional offices will be used for both mail-out

and return.

For units with less than 50 employees the error rate was by far larger by mail than by telephone. Since this difference was less pronounced for units with 50 or more employees and since mail contacts are cheaper, such units will be contacted initially by mail and units with less than 50 employees will be contacted initially by telephone. Because of the timeliness and better response of the telephone procedure all non-respondents of all sizes will be telephoned for data rather than using the less effective mail method.

The difference between response to Field Test II and the ES1 survey indicated that a quality control program is required to measure and control response errors.

(d) Quality Control Test

In October 1978, some 2,000 units were surveyed in order to gather information on selected items that affect the quality of the data in the ES1 survey, and supplement and confirm Field Test I information results.

In particular the results of this test supported results from previous field tests in that

- it will be possible to collect data for hours for wage earners;
- it is possible to obtain both overtime hours and pay separately for selected industries;
- special payments data can be reported separately for the majority of those units which make them;
- the salaried/hourly rated classifications should replace the present activity oriented classification.

(e) Field Test III

The final field test, Field Test III, was undertaken primarily as a "dress rehearsal" for much of the survey operations and systems and especially those associated with the "front-end" of the survey. This test included

- i) the use of the latest prototype of the survey questionnaire
- ii) field collection of data
- iii) testing of the proposed coding and editing procedures
- iv) testing of data capture processes, and
- v) testing of certain of the methodological aspects proposed to date.

The field work for this test for the reference months of January and February 1980 was conducted in February and March of 1980 respectively and used the facilities of two regional offices, Winnipeg and Halifax, as well as head office for data collection purposes. Data for four provinces were collected in this test and corresponding estimates are to be produced for these areas. Although the data collection processes have been completed, the final estimates have yet to be produced and most evaluations associated with the test are in their initial stages. Appropriate procedural amendments based on these evaluations will be built into the final production system coming into operation in 1981.

The sample size for the test process was determined using a similar procedure to that proposed for the final survey.

Based on an initial review of the field procedures, it is clear that substantial frame

problems are to be expected in the survey and that certain questionnaire modifications need to be made. It is also important to refine the field data control methods and establish firm lines of communication between the field officers and the operations centre of the survey.

Elements of the proposed evaluation include principally

- i) an evaluation of the full scope of the editing process applied in the test and the limited imputation techniques employed
- ii) a statistical comparison between the estimates produced in the current production process, those produced in the Field Test III and those produced in the LFS.
- iii) a review of the systems, field and manual procedures developed to date, and
- iv) an assessment of the difficulty in collecting special payments data.

(f) Parallel Run

It is planned to conduct simultaneously both the revised survey operation and the existing ES1, ES2 and GAP survey operations for a number of months. The objectives of this parallel run are

- i) to ensure that the revised survey is producing estimates which meet user requirements before terminating the current surveys
- ii) to obtain base data from the revised survey to be able to construct indexes, and
- iii) to produce estimates based on both surveys for a number of months in order to minimize the effect on users of the break in the series.

In order to reduce response burden, the units that are selected for both of the surveys during the Parallel Run will be required to fill in only the questionnaire of the revised survey. A link to transfer information from one survey to another is being developed to facilitate the production of estimates from both surveys.

SURVEY DESIGN

(a) Objectives of the Survey

The primary objectives of the monthly survey are

- i) to produce estimates of the total number of paid employees, average weekly wages and salaries, average hourly earnings and other variables for each province at the industry division level (which roughly corresponds to the 1 digit SIC code in the Standard Industrial Classification Manual), and
- ii) to produce national estimates for each three digit SIC for the variables above.

The monthly survey will measure levels of the above variables and not trends alone, since adequate benchmarks are not available on a current basis for the reasons described in the earlier part of the paper. It is not planned to supplement the monthly survey by an annual survey to produce estimates at a more detailed geographic level on an annual basis. The survey should be able to provide the following estimates annually:

- i) three digit SIC by province data for all the variables, and
- ii) sub-provincial data by some industry level less detailed than three digit SIC (depending on sample size) for some important variables.

All of the annual estimates will be averages of the twelve monthly estimates.

(b) Sampling Unit

The problem of choosing a sampling unit for the revised survey was considered keeping in view

- i) the present reporting structure in the current ES1 survey
- ii) the nature of the sampling frame as presently maintained
- iii) the use of the current survey data to disaggregate tax data for the purpose of benchmarking labour income estimates, and
- iv) the need for producing sub-provincial estimates.

Any company in the sampling frame with more than one employment reporting unit (ERU) is classified as a multi unit company and is included in the sample with certainty because

- i) it is thought that reporting for one ERU may be more difficult than reporting for them all, particularly for a rotating sample
- ii) ERU's within companies are thought to be often heterogeneous with respect to their employment characteristics, and
- iii) distributions of earnings by industry within multi unit companies are used for allocating T4 earnings within these companies to industries.

All the employment reporting units of these companies are requested to report data every month. The rest of the sampling frame, which forms the bulk of the population, consists of single establishment - single ERU companies.

(c) Stratification

The need for producing estimates both at the three digit SIC Canada level and the industry division province level leads to the stratification of sampling units by three digit SIC and province. There should be some control of the size (total number of paid employees) of a unit while selecting the sample.

For determining the stratum boundaries the frequency distribution of employment in the ES1 population and ES2 sample with size classes having small ranges was used. Creating equal intervals on the $\text{cum}\sqrt{f}$ scale gave approximately the five strata boundaries as 0-3, 4-11, 12-49, 50-199 and greater than or equal to 200 employees. Since there is no easy way of identifying all the units having 0-3, or 4-11 employees on the sampling frame¹, it has been decided to create four size strata with 0-19, 20-49, 50-199 and greater than or equal to 200 employees. These strata are labelled size groups 1,2,3 and 4. The above size stratification also facilitates comparison of the revised survey estimates with the current ES1 and ES2 survey estimates.

(d) Sample Size and Allocation^[6]

The sample size for the revised survey has been determined to provide estimates of the total number of paid employees with a prespecified coefficient of variation at the industry division and province level. For the determination of the sample size, the variance of the estimator under stratified random sampling was used under the requirement that the total sample in each industry division and province be allocated to each size stratum in proportion to the estimated total number of employees in that size stratum. This makes the probability of inclusion of a unit in the sample in a size stratum proportional to the average number of employees in that size stratum. This allocation is expected to be more efficient and closer to Neyman allocation than proportional allocation in view of the distribution of the number of employees being highly skewed. In fact 0.7% of the total number of employment reporting units account for 42% of employment.

The strategy has been to estimate sample sizes for various values of the coefficient of variation of the estimate at the industry division province level and choose that size which is convenient from a cost and operational point of view and which meets reasonable reliability requirements. It is estimated that a sample of 60,000 ERU's would be required to obtain estimates with a 2% coefficient of variation.

It has been possible to estimate the parameters in sample size determination using past data contained in a file labelled 'The Methodological Research File' (MRF). This file is a collection of datasets containing employment hours and earnings data on employment reporting units which responded during 1976 and 1977 to the ES1, ES2 and GAP surveys. The MRF has been a tremendous advantage in terms of the scope of methodological research that it has been possible to undertake in the development of the design of the survey.

The number of sampling units to be selected in the take-some portion of the population is allocated to each three digit SIC within industry division, province and size using proportional allocation. This number is summed over all size groups and provinces to give the number of units on which three digit SIC estimates are based. A study of the expected reliability of the three digit SIC estimates resulting from the above procedure has been made and is encouraging. Under the above sample size determination and allocation procedure the probability of inclusion of units in size group 4 turned out to be 1 in almost all cases. Therefore it was decided to include all size 4 units in the sample with certainty.

(e) Sample Selection

As indicated earlier, the sample size in each three digit SIC within an industry division, province and size is determined using the sampling fraction derived at the industry division, province and size level. A systematic sample is then drawn from each three digit SIC. If the number of units within a three digit SIC is not enough to give a sample of at least two units, then it is planned to collapse three digit

SIC's into selection groups such that a sample of at least 2 units is selected. This collapsing will be done in size groups 1 and 2 only.

The selection groups will be reviewed by subject matter specialists to ensure that they contain homogeneous SIC's with respect to average wages and salaries, seasonality, etc. In size group 3, it is planned to take a minimum sample of 2 units from each three digit SIC. Selection of units within a selection group will be systematic.

(f) Sample Rotation

Rotation of the sample in the revised survey is being considered mainly for the purpose of reducing response burden, especially for small employers. In order to balance the cost of rotation and reduce response burden, a rotation period of 12 months is planned. It is also planned to keep units out of the sample for at least 12 months after they rotate out as it is considered that it is more of a response burden to come back into the survey within 12 months than to continue reporting each month. For this reason, it may happen that, in some small strata units have to stay in the sample for more than 12 months. The chances of this happening are being minimized.

In order to maintain approximately the same reliability over time, it is planned to hold the sampling fraction determined at the time of sample size determination constant each month. When units rotate out of the sample, the size of the new rotation group is determined taking into account births, deaths, total units in the universe and the given sampling fraction. Therefore it is possible that though original rotation groups are approximately of the same size, they may become unequal over time. The effect of this on the rotation group bias has to be examined.

(g) Frame Changes

The methodology for handling frame changes, such as a change in SIC classification, province or size is being developed keeping in view

- i) the state of the current master file of sampling units
- ii) operational and cost considerations, and
- iii) the balance between the bias and the variability in the estimates of level and trend.

Births will be sampled at the same rate as the units already on the frame. By using the counts of the estimated number of deaths based on the sample and the number of deaths encountered each month on the frame, it is planned to reduce the bias in the estimates due to deaths.

(h) Edit of Month to Month Changes in the Reported Values

This edit is being designed primarily to detect 'outlier' changes in the values reported by the same unit for two consecutive months. Values of the key variables reported by a unit for one month are compared with the values reported by the same unit for the previous month. Any change not within the prespecified tolerance limit will be declared as an outlier and the reported value will be examined and corrections made if necessary. For arriving at these tolerance limits the distri-

bution of changes from one month to the next in the different size groups is being studied and it is planned to use the 95th percentile of this distribution as the approximate cut-off point. This edit is also expected to help identify the reasons for any large increase or decrease in the estimates.

(i) Imputation

Imputation for nonrespondent units which have been in the survey for more than one month will be based on the data for the previous month. It is planned to have a rigorous follow-up of non-respondents which have just rotated into the survey, in order to keep the imputation for these units to a minimum and to get them into the habit of responding. Imputation techniques are being developed for 'new' nonrespondents using the methodological research file. For example, the nonrespondents in the first size group have an average number of employees which is closer to the average of a particular subset of respondents in that group than to all respondents in that group. A partial imputation technique is being developed for those units for which incomplete data is available at the time of estimation.

(j) Estimation

The basic building block for producing the estimates in the revised survey is the three digit SIC, province and size. Techniques are being planned to handle outlier problems. A re-interview program is being considered in order to provide some means of checking whether concepts in the new questionnaire have been clearly understood by the respondents, identify the variables for which there is a response bias, and attempt to measure nonresponse bias. Attempts will be made to obtain measures of other non-sampling errors.

CONCLUSION

In this report, a broad summary of the progress made has been presented in the development of the ESDP over a five year period from 1976 to 1980

The provision by management, at the outset of the survey redesign process, of clear statements of project objectives and potential areas of investigation has enabled the development to remain firmly focussed on the final survey goals. In supporting the POT recommendation that no procedure or method be adopted for the survey without testing and evaluation, management has sponsored a large number of field tests and research tasks that have allowed objective decisions to be made on the procedures and methods to be used in the final survey process. The success of this project to date supports management in its view that the developmental strategy employed in the ESDP should be seen as a prototype for future developmental projects in Statistics Canada.

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FOOTNOTES

- 1 The ESDP was presented as an example in a paper by Fellegi and Ryten[1] which recommended an approach to the redevelopment of survey systems in Statistics Canada.
- 2 The T4 Supplementary file which carries total annual earnings data for each employed person for whom deductions were made and the payroll deduction account (PAYDAC) system which records monthly source deductions made on behalf of employees by employers were the files potentially available.
- 3 Statistics Canada has eight Regional Offices across Canada for data collection purposes.
- 4 The central business survey frame maintained by Statistics Canada and derived largely from the Revenue Canada-Taxation file of payroll deduction accounts.
- 5 "Error" designation was somewhat subjective: it included such items as legibility, use of fractions, results of comparison with ESI survey data, etc. The important point is that it was used the same way for mail and telephone.
- 6 Turnaround time refers to the time from the commencement of data collection (i.e. mailout and first telephone calls) to the time a questionnaire was completed and received in head office.
- 7 There is only one size code for 0-19 employees

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