Invited Session: Integrated systems and architectures for production of economic statistics

The Integrated Business Statistics Program: An Overview

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Introduction

In 2010, Statistics Canada (StatCan) launched the Corporate Business Architecture initiative which entailed a review of Statistics Canada’s business processes, methods and systems infrastructure. The objectives were to:
- achieve efficiencies,
- enhance quality assurance and
- improve responsiveness in the delivery of statistical programs.

Currently, the business statistics program at StatCan comprises approximately 250 surveys and administrative-based programs. Although the majority of these programs were developed in isolation, it there is a great deal of commonality between the processes used to produce the information. This determination led to the recommendation that the organization move towards the development of a generalized model for producing business statistics.

The model will largely make use of shared and generic corporate services and systems for collecting, processing, disseminating and storing statistical information. In addition, the surveys’ content is to be harmonized wherever possible, and the approach to data analysis is to be standardized more across the different programs.

The project to achieve this, the Integrated Business Statistics Program (IBSP) was launched in April 2010 with the objective of having all surveys covering the manufacturing, retail, wholesale and services sectors as well as capital expenditure activities using the new model by 2014. More surveys will be integrated in 2014 and 2015 using the same model.

The IBSP model is based, to some extent, on the existing Unified Enterprise Survey\(^1\) (UES) program (Brodeur et all 2006). The UES was implemented 15 years ago and its 58 surveys are integrated in terms of content, collection and data processing. The UES experience has proven that an integrated and consistent model for producing business statistics is not only possible but it is much more efficient than stand-alone customized solutions. However, to make such a model work successfully, strong governance which promotes the global versus the local optimum is absolutely necessary. Many lessons have been learnt both in terms of good practices and areas that could be improved. Some of the good practices are the use of generalized systems, harmonization of content, the use of a common frame and extensive use of tax information. The IBSP will build on these. One of the most important shortcomings of the UES was that instead of developing one common solution, there was a lot of customization introduced at each step of the process. This has translated into a model that is very complex, lacks flexibility and is very labour

\(^1\) The UES is a standardized approach for processing data from collection and administrative sources for 58 annual surveys covering the manufacturing, retail, services and aquaculture sectors.
intensive in terms of maintenance. The reason behind this shortcoming was the lack of strong governance as surveys were integrated into the UES model. This experience served as an important lesson for the IBSP team. It was recognized from the onset that ensuring strong governance of the project will be the key to ultimately achieving its objectives.

The first year of the project was dedicated to conducting extensive consultations with all the business programs slated for integration as well as with partners providing collection, methodology, and IT services. It was crucial that all requirements be well understood early on in order to determine the best approach for meeting them.

The project team also established a set of pillars which were seen as essential in meeting the high level objectives of the organization of increasing efficiency, augmenting quality and becoming more responsive to client needs.

This paper will focus on the major pillars of this project and the extent to which work to date has proved that they can become reality. These pillars are:

- Maximize the use of administrative information to reduce response burden and achieve cost efficiencies;
- Implement electronic questionnaires as the principal mode for data collection;
- Develop an electronic personalized approach to collecting data from large and complex enterprises;
- Use of active collection management to achieve cost efficiencies.

Maximize Use of Administrative Information

Statistics Canada has a long history of incorporating administrative data into its survey programs. Close cooperation with Canada Revenue Agency, the department responsible for administering Tax Policy in Canada, has led to substantial improvements in the quality of the data received. Research on the suitability and quality of tax information started first in the early 1990s and immense progress has been achieved since. StatCan has developed a comprehensive process of “cleaning” the tax files and preparing them for use in its statistical programs. Currently the UES uses tax information to replace some financial data for a large percentage of single-establishment enterprises. The goal of the IBSP was to expand this use. There were a number of steps that were taken to achieve this:

1. Harmonizing financial questionnaire content across business surveys
2. Updating concordances between tax and survey variables to facilitate data substitution
3. Determining the upper limit for tax data usage across economic programs

The vast majority of business surveys at StatCan collect detailed revenue and expense data, and a thorough evaluation of the questions used to collect these data was undertaken. The objectives of the review were to identify all the concepts being covered and to determine if standardized questions could be used to collect the required conceptual information. This work led to the development of generic questionnaire modules. Each module is a set of standardized questions grouped by type (e.g. revenues, expenses, inventories, etc.) to collect information responding to a conceptual requirement.
The idea was to develop a modular questionnaire that will have several generic modules (questions common across a majority of surveys) and modules specific to a given survey (e.g. containing questions on research and development, manufacturing inputs, etc.). Harmonizing the content had a number of benefits:

- Standard content modules could be applied to collect information for new industries or activities without additional research
- Efficiencies in developing paper and electronic questionnaires by reducing development time
- Efficiencies in developing data processing systems
- Improving coherence across surveys by measuring concepts the same way.

After the financial content was harmonized the next step was to re-assess an existing concordance between economic and fiscal concepts. It is a well-known fact that economic and fiscal concepts are sometimes different and care must be used in relating tax information to economic concepts normally covered by surveys. A number of years ago, StatCan developed a concordance between the two, the Chart of Accounts (Statistics Canada 2004).

The Chart of Accounts was reviewed (Martineau 2011) with the intention of maximizing tax data usage based on adopting harmonized content. After studying different assumptions and various scenarios, the reviewers concluded that the most effective way to promote the use of tax data would be to change survey questions to make them as consistent as possible with the different subsections of the GIFI. This option was ultimately chosen and the result of the exercise was that in a number of instances, such as the cost of purchased services, tax information will be used for totals and only the detail will be collected for targeted industries. Even though new content was added to the surveys, the tax replacement strategy allowed for a decrease in the number of total cells by approximately 6%.

Following the content review, the next step was to investigate the types of enterprises for which tax data could be used. The Canadian fiscal system requires statistical input at a provincial level. Tax information only provides data at the legal entity level and for large, complex businesses this level often cuts across geographic boundaries. A number of studies were conducted and it was determined that high quality information could be produced by replacing survey data with tax information for all enterprises that have one location or that have multiple locations operating in only one province. Therefore these companies will at most receive a short questionnaire asking for information not available from administrative sources. This will lead to further reduction in the response burden imposed on enterprises.

**Implement electronic questionnaires as principal mode of data collection**

Until recently, StatCan has made only modest attempts to use Electronic Questionnaires (EQ) as a means of collecting information for economic surveys. The majority of business surveys currently use paper questionnaires coupled with telephone and fax follow-up. One of the objectives of the IBSP is to implement the EQ as the principal mode of collection. The reason behind this strategy is two-fold:

- Meet respondents’ needs
- Reduce expenditures for collection activities
Given the limited experience with the EQ, it was thought prudent to start “introducing” this approach on a trial basis for some industries even before the IBSP was in production to permit adjustments before EQ is implemented on a large scale. Therefore, for reference year 2010, respondents for seven existing surveys were offered the option of responding via the EQ. The take-up rate was 69.3%.

An experiment (Claveau, Leung, Turmelle and Gilbert 2011) was set up whereby those who accepted the EQ were divided into four groups who were to be subject to four different follow-up treatments:

- T1: 1st attempt by e-mail and then phone and e-mail follow-up
- T2: e-mails only
- T3: 1st attempt by phone and then phone and e-mail follow-ups
- T4: 1st attempt by phone and then e-mails only

The objective was to determine which approach was most efficient based on a combination of response rate and follow-up costs. The experiment was run over a 3 month collection period. Table 1 below shows the cumulative return rate for each treatment. The results showed that the four different treatments resulted in very similar response rates. However the treatment for group 2 was the least expensive since respondents did not receive phone calls for the duration of the study.

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2 The seven surveys covered the following industries: head office, specialized design services, accounting services, management consulting services, engineering services, architecture services and software development and computer services.
Another important finding was that e-mail reminders work only up to a certain point in time. Eventually, response rates plateau and if higher response is required then telephone follow up calls must be made.

Other interesting findings were that:

- When we compare the collection methods (electronic and paper), the differences between the number of reported cell values were negligible

- a reduction in the number of erroneous reports for EQ when comparing with paper questionnaires. Table 2 below shows the comparison. This translates into less effort required to resolve erroneous reports.

- The electronic questionnaire collection obtained a faster response time when compared with the mail out/mail back method. By September 16th, the weighted response rate for EQ was 73.4% compared to 57.6 for mail.
Develop a personalized approach to collecting data from large and complex enterprises

A large and complex enterprise is one that has multiple reporting entities for a single respondent. There are approximately 400 of these enterprises in StatCan surveys and in some industries they account for up to 50% of the total value. More often than not, these enterprises span industries. As questionnaires’ content differs by industry, the respondent would receive a multitude of questionnaires to fill in for one enterprise. This could amount to a lot of burden for some respondents. To alleviate some of that burden, StatCan has negotiated special arrangements with some of these respondents including:

- Providing customized Excel spreadsheets that allow respondents to report for multiple entities across different industries via one company specific spreadsheet
- Allowing respondents to send “dumps” of data from their accounting systems.

The obvious drawback to these highly customized methods of collection is the effort required to capture and map some of these reports to the standard set of data required by the survey process. One of the objectives of the IBSP project is to propose a solution that would continue to permit StatCan to minimize response burden for these large and complex enterprises while decreasing the effort required for processing the information received. The solution that was proposed and is being tested is an electronic spreadsheet that:

- uses the standard content cells from the regular questionnaires
- has the cells tagged for automatic data capture
- has respondent collection information (e.g. name and location of reporting entities, industry) automatically populated through metadata
- contains historical information previously reported
- the custom spreadsheet can be sent and received using a secure Electronic File Transfer System
- separate for annual and sub-annual reports

This proposal will continue to allow respondents to provide all the information for their many reporting entities via one questionnaire although it would reduce the amount of flexibility with respect to the type of information reported. StatCan would gain efficiency from an automatic capture of the information via

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<tr>
<th>SURVEY</th>
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<td>0.9%</td>
<td>3.1%</td>
<td>2.0%</td>
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Table 1
the tagged cells. This is expected to save a considerable amount of time and resources and, more importantly improve the quality of the data by eliminating a lot of manual interventions and mapping of the data. So far, the team has designed the standard look of the questionnaire and they have tested populating respondent information via metadata. In the months to come we will be looking at different methods for automatically capturing the information received via these spreadsheets.

Use of active collection management to achieve cost efficiencies – the use of The Rolling Estimates approach

Currently, the UES program uses what we refer to as a linear model for processing collected and administrative data. By this we mean that information is processed through a given step (e.g. imputation) and once that step is completed the data proceeds through the next step without ever returning to the previous one. There is manual intervention on the part of analysts after virtually every step in the process. There are a number of disadvantages to this approach:

- There is no interactive connection between the collection efforts and the quality of the final estimates as the post-collection processes start after collection has been closed.
- The analysts focus most of their efforts on vetting micro data information since they only see the final estimates after the last step in the process.
- A great deal of manual correction by the analysts may result in very little benefit when put in the perspective of impact on the final estimates.

The IBSP is proposing an iterative approach (Saint-Pierre and Bricault 2011) to the entire survey process cycle. Under this scenario, data will be processed and estimates will be tabulated as soon as there is sufficient collected data and administrative information available. The analysts would start by looking at the estimates and only correct high impact contributors. Collection would continue and the entire process would be repeated a few times until the estimates are deemed to have reached the desired level of quality at which point collection would stop and analysts would only put the final touches on the estimates.

The proposed approach is depicted in Figure 2 below.

Figure 2
There are a number of advantages associated with his approach. First of all the number of manual interventions by subject matter analysts will be significantly reduced. Also these interventions would be targeted better as the analysts would start by looking at the estimates and then work their way down to the major contributors that need to be adjusted. It is also hoped that this approach will reduce the time needed to complete the analysis and disseminate results. This is because analysts will have an early indication of the estimates rather than waiting till the end of the process as they do now. This approach contrasts with the current linear process where several manual interventions are done to the micro-data even before an estimate is being calculated.

There is also an important element that is being introduced with this approach: it is the connection between the collection process and the quality of the estimates. It is known as the active collection management process and the goal is to target units for non-response and edit follow-up based on their impact on the quality of estimates. It will work in the following fashion:

1. Quality indicator (QI) targets will be established by domain of estimation at the onset of the process.
2. As each iteration of the estimates is run, the domains for which quality targets have been reached will be identified and any active collection efforts (non-response or edit follow-up) for units in these domains will cease. Collection efforts will be redirected towards units that belong to domains for which the target quality has not yet been reached.
3. A measure of impact (MI) will be calculated for each unit in the sample; this measure will be used to prioritize collection follow-up efforts.

The potential QIs will be output-oriented and include various types of rates (response, coverage, reported or imputation rates, percentage of records with data for key variables). The estimated variance is also another indicator to be considered since it is directly related to the quality of the estimates. Few quality measures could be calculated based on a limited number of key variables. The calculation of a global QI by domain of estimation is essential to derive efficient prioritization rules.

While the methodology to calculate the QIs will be similar across all surveys, the key variables and the quality targets will not be the same. The key variables used in the calculations of the QI will be defined by subject matter staff.

Within a domain of estimation units will be ranked based on their impact on the quality of the estimation for the domain. The measure of impact could be calculated from variables that are unique to a survey or common across some surveys, depending on what the surveys are trying to measure.

If the QI is under the target level, only units identified as influential will be followed-up. Amongst the influential units flagged for follow-up, the priority will be assigned based on the MI score. The non-respondent unit with the highest MI score (above a pre-defined threshold) in a domain of estimation with a QI under the target level will be assigned the highest priority for the non-response follow-up. Units with failed edits on key variables, with a high MI score and in a domain with a low QI will be the primary focus of the failed edits follow-up. Outcomes from the follow-ups will be integrated into the next run of Rolling Estimates. Non-response of non-influential records (low MI score) will not require a follow-up (except if required to measure the
non-response bias) but will automatically be resolved via imputation or re-weighting. Failed edits for non-influential records would most likely be overridden and the original data provided by the respondent kept intact (if coherent) since the impact on the estimates will be negligible. These records will be identified as “fit for use”. Figure 2 summarizes the various possible actions based on the combinations of QI and MI score.

Table 2 – The Active Collection Management is driven by Quality Indicators and Measures of Impact

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<thead>
<tr>
<th>MI &gt; Threshold (influential records)</th>
<th>Active Collection - Actions</th>
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</thead>
<tbody>
<tr>
<td>MI &gt; Threshold (influential records)</td>
<td>QI &gt; Target Level</td>
</tr>
<tr>
<td>Response - No Failed Edits</td>
<td>No Follow-up</td>
</tr>
<tr>
<td>Response - Failed Edits</td>
<td>No Follow-up</td>
</tr>
<tr>
<td>Non-response</td>
<td>No Follow-up</td>
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<table>
<thead>
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<th>MI&lt; Threshold (Non-influential records)</th>
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</table>

If non-response follow-ups on influential records are not successful enough to obtain the target QI, some non-influential records units will have be promoted as influential units in subsequent iterations and then followed-up. Once all domains in a survey reach their quality target, the active collection can be closed for that survey.

There are a number of challenges associated with the implementation of the Rolling Estimates approach. A system needs to be built that allows for a quick and seamless flow of data and paradata through a number of different processes: collection, integration of administrative information, edit and imputation, allocation and estimation. StatCan relies heavily on the use of generalized systems for many of these steps; however the connections between them must be efficient. A balance must also be achieved between the data quality desired and the volume of units that can be subject to follow-up efforts: quality indicators and quality targets must be fine-tuned to ensure that we aim for realistic objectives. Currently, efforts are directed towards ensuring that the system being built to support the Rolling Estimates approach will allow for efficient processing of high volumes of data through a number of interconnected platforms. There are also tests in progress using various proposed QI measures to determine which would provide the best tool for actively managing collection.

Conclusion

The IBSP has just completed the second year of the four year project. Some of the ideas and initiatives described above (content harmonization) have already been tested and proven to work. Others, such as

³ Follow-ups could be performed to measure the non-response bias.
the active collection management strategy are still in their developmental phase and much work remains to be done to ensure that it will work as expected.

A great deal of collaboration between numerous teams in the Agency has been crucial to achieve the progress made to date. This collaboration was achieve by engaging the numerous partners in the decision making process and, more importantly by ensuring that the high level goals of the Agency as well as the pillars of the project were constantly being communicated. The success of the project will not only be measured by its deliverables but rather by the adoption or buy in of the new model by all areas involved. This can only be achieved by communicating clearly and frequently why this direction has been taken and also by involving all stakeholders in the development and testing phases of the project. Up until now the project has adopted an approach that makes extensive use of prototypes to both gage the reaction of the users and to help clarify requirements. This has proven very successful on both fronts.

A very strong governance framework was put in place at the initial phase of the project and it continues to be maintained. This is essential to ensure that there are no significant deviations from the initial goals and to provide an efficient and clear resolution channel for the issues that come up.

References


Martineau P. (2011), Use of the Chart of Accounts in determining the content of Statistics Canada business surveys, Statistics Canada, Internal document
