Development of a SAS® Dashboard to Support Administrative Data Collection Processes

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Abstract

The U.S. Energy Information Administration (EIA) collects, analyzes, and disseminates independent and impartial energy information for multiple audiences and purposes. EIA collects data via more than 50 surveys. As part of EIA's survey business process, the survey managers who oversee these surveys regularly monitor data collection via a series of reports at each stage of the collection and data editing process. The authors developed a dashboard system to provide survey managers one central location from which to retrieve these reports.

Reports were identified for comparison across different energy data collection programs, to address the survey business processes, including reports providing data on frame management and on response. The focus of this paper will be the development of a subset of reports that address common data needs for monitoring response during data collection. The development process facilitates understanding the challenges which occurred while designing and building this dashboard system. These challenges included the identification of commonalities and differences in information needs of different survey staff, the development of common definitions for survey terms across reports, and the computation of statistics within this common framework.

Introduction

How do you monitor survey processes in an organization with disparate data collection methods, disparate methods for monitoring survey processes, and disparate terminology both for data collection and monitoring? This is often a challenge for organizations whose data collection methods grow organically, and whose institutional structure allows multiple collection instruments and data review systems to develop. The U.S. Energy Information Administration (EIA), the statistical and analytical agency within the U.S. Department of Energy, is one such organization. Historically, EIA's organizational structure was comprised of multiple program offices organized around different energy sources. This structure supported EIA's mission of collecting and disseminating energy data while allowing for the expansion of new data collection and dissemination methods for these data. Each program office included staff who aided in survey development as well as staff responsible for information technology support as a part of its team. The structure also encouraged the development of survey language and performance metrics specialized to each program office rather than standardized across EIA. It also facilitated the development of disparate data collection methods varied across multiple energy types and disparate methods for monitoring survey processes and data.

In October 2010, EIA's organizational structure changed, resulting in the creation of offices defined by function. As part of this reorganization, survey development support staff moved from each program office into a newly created office dedicated to all aspects of survey development including questionnaire design, the development of sampling methodologies, and the development of and survey methodologies. Similarly, staff that coordinated and provided information technology support for the collection of survey data moved from individual program offices into a new office dedicated to providing this support EIA-wide. This achieved one of the stated goals of the reorganization: increasing efficiency by placing staff with similar skill sets into similar work groups. More importantly, it created offices that could provide targeted support for data collection tools and for data collection monitoring that need not be program-office specific. Post-reorganization, information technology specialists could partner with multiple

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energy offices to continue the development of a unified data collection instrument already underway at EIA.   Staff specialized in survey development could work with multiple program offices to revise or develop new surveys. Survey development staff could work with program offices to develop EIA-wide metrics with which to monitor surveys.   In fact, all of these possibilities are being realized at EIA.

Survey development specialists now offer survey development support to multiple energy offices. They are working to develop common survey processes that can be implemented alongside the deployment of the new common data collection tool. A project is also underway in which survey development specialists are designing metrics that can aid multiple program offices and program office staff in monitoring survey processes at EIA.   As a part of the effort to design these new metrics, close attention has been paid both to theory from survey methodology and to the practical application of theory in developing metrics that address the needs of the program office staff who will be using them.   In considering how best to design these metrics we considered four questions: Which survey processes are we interested in monitoring?   Which metrics should be used to monitor these processes? What data should be used to calculate these metrics? What is the best and most efficient way to communicate these metrics to program office managers, survey managers and survey staff in program offices? We answer these questions in three ways. First we use survey methodology research as it can be applied regardless of the survey type, e.g. household or establishment. Then we use data from our own research conducted as part of the development process to understand how the survey processes that we have identified are carried out at EIA, and which metrics are used to monitor these survey processes. Finally we combine best practices from survey methodology and research on survey processes at EIA to design prototypes of metrics for use EIA-wide.   We finally discuss ways to disseminate these metrics, providing an overview of a prototype dashboard currently in development at EIA for that purpose.

Which Survey Processes are We Interested in Monitoring?

In order to answer the first research question " What survey processes are we interested in monitoring?" we needed a comprehensive list of all of the possible processes involved in conducting a survey. We used the survey lifecycle to represent these processes.   There are common elements of each survey lifecycle that occur irrespective of the method used to conduct the survey (Groves et al., 2004). The survey lifecycle is preceded by the identification of a topic of interest by researchers. After the topic about which data are collected is identified, the survey lifecycle begins with a discussion by survey methodologists and researchers about the mode of collection and questionnaire design.   Once a mode of collection has been agreed upon and a questionnaire designed, the questionnaire is constructed and pretested according to best practices.

The demands of survey development often mean that the linear nature of development requires deviation from the order in which these steps are presented.   However, in theory, the selection of a sampling frame follows the pretesting of the questionnaire.   The sampling frame is populated by the members of the target population who have a chance to be selected into a survey sample.   Next, a subset of the sampling frame is designed and selected. The subset or sampling frame is the group that will provide the raw data used to construct measurements (Groves et al., 2004). In some surveys, all units in the sampling frame will be asked to provide these raw data. After the sample has been designed, the data collection phase begins. This phase combines questionnaire design and the sample selection.   During this stage of the survey lifecycle, survey staff pay close attention to collecting measurements from as much of the sample as possible.   During and after data collection, data are edited and coded and then compiled into a file for use in publication and analysis.   Finally the data undergo post-survey adjustments to address coverage, sampling, nonresponse or other errors, where appropriate (Groves, et al. 2004).   Now that we have a comprehensive list of potential survey processes, we can begin the process of deciding which of these processes should be monitored by program office staff.

We did so by identifying staff members who could reasonably be expected to participate in completing the processes associated with each lifecycle element.   For example, researchers are involved in determining a topic about which data would be collected. Survey methodologists, survey managers, statisticians and researchers might work together to determine the mode of survey collection and design an optimal questionnaire.   Survey methodologists would test the questionnaire. Survey methodologists and statisticians are involved in designing the sample. Program office staff are involved in data collection, data editing and coding, and preparing data files for analysis. After completing this exercise, we identified the survey processes that we were interested in monitoring based on the roles associated with those processes.

In this case, our goal was to aid program office survey staff in monitoring survey processes. Thus we eliminated any processes from contention that were not associated with program office survey staff. This left only the processes involved in data collection, data editing and coding, and the preparation of a data file for analysis. Using this logic we selected metrics that would aid these staff in monitoring processes associated with data collection. These metrics should be informed by the types of errors associated with each of the processes in the survey lifecycle that are to be monitored.

Which Metrics Should Be Used to Monitor these Processes?

Survey methodologists define a set of four quality concepts associated with mismatches that arise between each step of the survey lifecycle: coverage error, sampling error, nonresponse error, and adjusted error (Groves et al., 2004). Coverage error occurs when the available sampling frame is not matched perfectly to the target population. One consequence of coverage error is that the members of the target population not represented in the sampling frame may be significantly different in some way from the members of the sampling frame (Groves et al., 2004). Sampling error is attributed to the fact that only a subset of the sampling frame is measured, and the remainder of the sampling frame is not measured. Sampling error is introduced when measuring a subset of the sampling frame results in a sample statistic that is significantly different from the sample statistic generated using measurements from the entire sampling frame (Groves et al., 2004). Nonresponse error relates to the fact that not all of the members of the sample are successfully measured in a survey. The error is introduced when the distribution of the values of data collected from respondents differ significantly from the distribution of the values of data collected from the full sample. During the last step of data collection, adjustments are made to the survey data to account for coverage, and nonresponse error in the sample data. Adjustment error is the error associated with the variance between the sample statistic and population parameter as a result of the adjustments made to the data (Groves et al., 2004). Again we compared the list of errors with the survey processes to which they are most closely associated, and then selected the errors which metrics should monitor based on their association with the data collection process. This process identified both adjustment error and nonresponse errors. However, adjustment errors are out of scope for this project because they involve estimates generated after data collection, and not while collection is in the field. This led us to select nonresponse error as the primary error that the metrics should be used to measure as best practice for monitoring data collection practices by survey staff.

In fact, survey methodologists are concerned primarily with nonresponse error during data collection. One way to monitor nonresponse error is to monitor response and nonresponse closely during collection (Groves et al., 2004). In the most basic measurement of nonresponse, survey managers count the number of eligible entities who have not responded to the survey. Methodologists and survey managers alike can also monitor the response rate, or the number of entities who respond divided by the total number of entities in the sample or frame (Petroni et al., 2004). This is the first metric that we decided to include based on the multi-stage decision making-process that incorporates best practices from survey methodology. Understanding who will use the metric, and what their roles are during the survey lifecycle is the first step. Identifying errors that are associated with these same survey processes will suggest appropriate metrics for measuring these errors is the next step. However, the process must also account for the type of data collection being conducted- be it a household survey or an establishment survey. Because our goal was to develop metrics for use at EIA, and EIA primarily collects establishment data, we also considered unique features of establishment surveys that would inform our decision about the metrics that should be used to monitor nonresponse for establishment surveys.

What Type of Data Does EIA Collect and How Does it Impact Survey Metrics?

EIA collects data primarily about establishments. Establishments are usually defined as "as an economic unit, generally at a single physical location, where business is conducted or services or industrial operations are performed" (Federal Committee on Statistical Methodology 1988). Establishment surveys generally include one or two key data elements that must be captured because these elements are inputs into key economic indicators. In addition, the population of interest for establishment surveys is often skewed—comprised of a small number of large establishments and a larger number of small establishments (Willimack, et al 2004). The larger establishments contribute more to sample estimates than do the many smaller establishments. Because of this, in establishment surveys large establishments are selected with certainty into the sample to ensure adequate coverage and to minimize variance in the sample estimate. Since the population of interest in establishment surveys is likely to be skewed, establishment data also are skewed, as the larger establishments tend to contribute more to the sample

estimate than do the smaller establishments. These skewed data suggest an additional metric is necessary to monitor nonresponse rates in establishment surveys. This metric is the weighted response rate, which provides an estimate of the percent of a total sample estimate that each company has contributed. This is especially important for agencies like EIA who employ cut-off sampling as it aids in determining when the sample estimate cut-off has been reached (Knaub 2008). Now that we have identify unweighted and weighted response rates as the two metrics which should be used at EIA to monitor nonresponse error during data collection processes, we must identify the data that will be used to calculate these rates, again first using guidance from survey methodology research. Survey methodologists often rely on paradata to provide the inputs used to calculate survey metrics.

Where Will the Data Come From to Generate Metrics?

These computer-assisted data collection instruments produce paradata. The term paradata was first used to describe automatically-generated data about collection processes, but the definition was expanded to include data collected by interviewers, and by other systems (Couper 1998). Time stamps, call records, and interviewer observations are all examples of paradata (Kreuter and Casas-Cordero 2010). Paradata are also collected at different times during the data collection process. For example, call records collected while the interviewer is attempting to reach a designated case produce paradata such as call outcomes, the time contact was made, and the day that contact was made (Kreuter and Casas-Cordero 2010). Paradata also include interviewer observations made during the interview itself (Kreuter and Casas-Cordero 2010). In web-based surveys, paradata refer to the amount of time a respondent spent on each screen. Paradata collected in web-based surveys also includes the time at which a respondent abandoned the survey, and missing data items (Couper 1998).

Paradata can be used by survey to monitor survey processes during data collection. Using operational data elements such as response rates, survey managers can continuously monitor survey progress status updates (Couper and Lyberg 2005). Operational data elements such as time per unit and cost per unit collected also may be used to monitor the resources being used to collect the data (Laflamme et al., 2008). Monitoring these elements can aid in making sure that resources are being allocated efficiently, as well as allowing survey managers to shift resources as needed to better collect data while the survey is in the field. One drawback to using paradata to calculate these metrics at EIA, however, are that the majority of the data described above are generated during household surveys because household surveys are more likely to be administered by interviewers. These interviewers are likely to be using computer-assisted interview software, and the paradata used are generated by those systems.

However, as we have noted, EIA primarily conducts establishment surveys. These establishment surveys are more likely to be self-administered because it is assumed that in establishment surveys the data being collected are measuring data already available in the establishment's records (Willimack, et al 2004). Thus the extensive amount of paradata available from household surveys may not be generated for establishment surveys. We hope eventually to use data output from the web-based collection tool Web-based collection systems may generate paradata on establishment surveys and survey processes. EIA is currently developing a web-based collection system to unify collection processes. We hope to use paradata output from this system to calculate these metrics use them to help survey staff monitor data collection processes at EIA. We've now answered three of the four questions we hoped to address using survey methodology research. We know how to identify the survey processes we wish to monitor using the survey lifecycle as a framework. We understand how to identify the metrics that should be used to monitor these processes. We even understand where we might find data to calculate these metrics. But the most important question – how to communicate these metrics- is not yet answered.

What is the Best and Most Efficient Way to Communicate these Metrics?

One solution currently being used by Statistics Canada is a system designed as a 'paradata repository' out of which a series of standardized reports, customized reports, and data quality indicators are produced (Laflamme et al., 2008). This system provides real-time monitoring of indicators ranging from collection costs and response rates to interviewer production and interviewer costs. Another solution is the use of a dashboard to disseminate reports and indicators to monitor survey processes. A dashboard is "a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance" (Few 2006). A dashboard was used during the field collection of the Continuous National Survey of Family Growth, is the development of a reporting application that provides a series of key indicators calculated

using paradata. This dashboard is designed to provide real-time data that can be used to monitor a household survey being collected in the field (Lepkowski et al., 2010).

Even so, we were intrigued by the idea of a dashboard for use at EIA. Research written about the dashboard used to monitor household data collection suggested that it was an effective way to communicate key indicators to survey staff quickly, and in a way that would inform collection processes. This suggested to us that we should also pursue the development of a dashboard for EIA staff that communicated the two nonresponse metrics, unweighted and weighted response rates. We also thought that our development process would contribute to the literature in designing efficient reporting mechanisms on data collection processes at statistical agencies.

We brought some knowledge to the development process. We knew that EIA's organizational structure prior to 2010 allowed program offices to develop their own ways of monitoring surveys, facilitated by in house survey methods staff, statisticians, applications programmers and IT staff. We also knew from our research that there were processes that survey staff in these program offices were responsible for monitoring. But we needed to know more about how EIA survey staff carried out these activities, and as with the metrics defined above, where the data would come from. We needed answers to these questions: How do EIA survey staff monitor each aspect of data collection? How do EIA staff monitor nonresponse during data collection? What tools do EIA staff have to monitor survey processes? Where do the data come from that are used to calculate any existing metrics that EIA staff use to monitor this process? To answer these questions we conducted a series of semi-structured interviews with EIA survey staff.

Semi-Structured Interviews at EIA

We conducted these interviews with three of the four EIA Office of Energy Statistics (OES) program offices responsible for data collection. These offices were: the Office of Electricity, Renewables and Uranium Statistics; the Office of Oil, Gas, and Coal Supply Statistics; and the Office of Petroleum and Biofuels Statistics. We excluded a fourth office responsible for collecting data on energy consumption by households, buildings and manufacturing plants either in concert with outside firms or with other Federal agencies. From these three offices, we collected data from each of the nine energy teams making up the three offices. We interviewed the program managers responsible for managing the energy teams; the survey managers responsible for overseeing individual surveys; and the survey staff—both Federal and contractor—responsible for day-to-day survey operations.

These interviews were conducted with the assistance of Grace O'Neill and Kenneth Pick, both members of the EIA OES Survey Development Team. The interviews typically lasted one hour. They were conducted separately with program office managers, survey managers, and survey staff. We separated these staff into groups because each group performs different survey management tasks during the survey lifecycle. As a result it was probable that each group monitored data collection processes differently. The survey managers and survey staff were selected to participate in the interviews based upon recommendations from their program office manager.

Semi-Structured Interview Questions

We designed a protocol for these interviews to learn how each subpopulation monitors monthly surveys; what tools these groups have to monitor these surveys; and how nonresponse is monitored during data collection. This protocol is provided in Appendix A: Topic Guide. We first conducted a listing exercise with each group. As part of this exercise we asked "Which elements of the survey process do you oversee?" and "Are there certain times during the survey cycle that you review information on specific elements of the survey process?"

In the next part of the Topic Guide, we asked more specifically whether or not each energy group used tools like reports to monitor their survey or surveys. If each group said that they used reports, we then probed to learn how each group used these tools to monitor response and to support frames maintenance. We tried to determine which metrics are used to assess data quality as well as how reports are currently used to support this assessment. We also included questions about report functionality.

In the next section of the Topic Guide, we asked specifically about frames maintenance and response rates: "How are you using administrative reports to maintain frames?" and collected specific information on the type of information available, when during the survey lifecycle the information is available, and how reports are shared

between management and staff. Questions about frames maintenance were difficult for most staff to answer, and we eventually modified the Topic Guide to focus only on monitoring response.

We asked not only about the reports used to monitor response rates for the survey as a whole, but also about response rates monitored at the entity level, and then about the respondents themselves. We concluded these interviews by asking about how current reports are accessed, and about how easy they are to understand, asking specifically: "Again thinking about the frame and response rate information, if you did not know anything about your respondents – if you were brand new to EIA, what kind of information would you find confusing? What would you like clarified?" We concluded our interviews by requesting that program office managers, survey managers, and survey staff provide us with a copy of frequently used reports. A similar topic guide was used to interview each group to minimize variance in the type of data being collected.   The original Topic Guide for these interviews is provided in Appendix A and reflects our intent to collect data both on response rate monitoring and frames maintenance.

Data Collection and Analysis

We conducted 32 interviews with 47 EIA Federal staff and contractors over the course of six weeks. Of these 47, 7 were program office managers, 24 were survey managers and 16 were survey staff. They represented all of the energy program offices that were in scope.   After the interviews were completed, we prepared our notes and sent them to interview participants for their review. We finalized these notes and used them to conduct a thorough qualitative analysis to answer these questions: How does EIA collect data, and what aspects of collection processes are survey staff responsible for? What tools do EIA staff have to monitor these survey processes?

We grounded our analysis in four assumptions. We first assumed that some set of survey monitoring processes exist at EIA. Secondly we assumed that reports exist at EIA that are used to aid in survey monitoring processes. We assumed that the sample of EIA staff and contractors held sufficient institutional knowledge of these survey monitoring processes and reports to make our analysis a sound one. We finally assumed that a set of metrics are defined for establishment surveys that allow us to extrapolate our analysis to metrics for use at EIA.

We conducted our analysis in five steps. We first consolidated the myriad number of observations recorded during our interviews. We carefully noted common and disparate patterns in data collection methods and in data processing systems. We then identified survey monitoring practices common to all offices.   We observed features of reports used by the energy groups. We then identified common operational data elements used by the various energy groups to monitor response and nonresponse, and to conduct nonresponse follow-up. This method for conducting research and analyzing the outcomes can be generalized and used by any organization that finds itself with disparate collection and monitoring methods. Our analysis is limited in that the outcomes of the analysis are applicable to EIA only. While the focus of our interviews were the questions about how EIA staff monitored survey processes, we quickly learned that before we could understand the processes, we needed to understand the language that EIA survey staff used to describe the processes.   EIA's survey terminology differs slightly from the language that survey methodologists use, and so we will briefly discuss this terminology below.

Survey Terminology at EIA

EIA's survey terminology grew out of the heterogeneous research methods of its staff, which include economists, engineers, energy experts, statisticians, computer scientists and survey methodologists. We provide a brief list of terms and definitions commonly used at EIA below. This table provides a crosswalk between the language of survey methodologists and the terminology used at EIA.   These terms describe collection instruments and computing systems.

Table 1: EIA Survey Terminology

EIA Terminology	Definition
Initialization	At EIA, this refers to sample selection. It may also include the steps taken to begin data collection, such as notifying the sample members or sampling frame that data collection process will begin soon.
Survey Cycle	The survey reporting period, or reference period.
Collection	The data collection process.
Quality Checks	This incorporates both data quality review and the process of adjustment when necessary.
Frame system	There are several frame systems at EIA. These systems are usually computerized, and house data about the frames. These systems are also the applications into which frame data are entered.
Frame management	The process of identifying new potential respondents as well as sample management; also the process of correcting respondent data in the frame system including deactivating respondents no longer in business or no longer meeting the definitions for particular sampling frames.
Electronic data collection systems	Electronic data collection at EIA generally refers to a Secure File Transfer option for submitting forms programmed in Microsoft Excel, web-based collection instruments, or the ability to submit Excel files via e-mail.

Monitoring Data Collection Processes at EIA

Using these terms, we can analyze the data from interviews to understand the data collection process at EIA, and the staff and systems that support this collection process. We needed to understand the roles that survey staff play in data collection at EIA. As we began to discuss data collection with survey staff at EIA, it became clear that there are two principal data collection models at EIA, and that these two models create two different types of processes and systems to support these processes.

Collecting Data at EIA

We identified two data collection models in use at EIA — Model A and Model B. In Model A, the respondent provides data with minimal editing. Data can be submitted on paper forms or via an electronic collection instrument. The respondent can provide survey data either manually via fax and phone, or electronically via e-mail or secure file transfer. The data collection process for EIA staff begins after the respondents provide their data. A team of contractors not affiliated with any one energy program office manually enter the data provided on paper forms into a data collection module.   If the respondents submit data using the electronic collection instrument, these data are saved to a database, and then transferred into the same data collection module. This module also provides a place for survey staff to document their communication with respondents while conducting nonresponse follow-up and follow-up on responses that are identified by the automatic edits as being problematic. After data are entered, data files are processed for quality assurance in a second system. While this second system is predominant, other more specialized systems also are used in some instances.

In Model B, respondents correct their own errors prior to data submittal.   Respondents submit data primarily via web-based forms, which are coupled with internet data collection systems. These forms require more careful editing by respondents before the forms are accepted by the internet data collection system. The systems used in Model B reflect a more automated collection method. In contrast with Model A, survey managers initialize and open surveys in a second computer system. This second computer system is also a frame management system. However, similarly to Model A, a separate system is used to process data files and to conduct quality assurance. Also as with Model A, in Model B there is one predominant system used for quality assurance, but some program offices also have separate quality review processes and programs.

After analyzing the conversations with EIA staff, we understand that there are two data collection models at EIA: one manual and one more automatic. These two models resulted in the same data collection processes– data were

collected, edited and compiled. However these models resulted in the development of different systems used to complete these processes. This is an important distinction because these different systems provide different tools to monitor data collection processes. These tools are an important component of the question: How do survey staff monitor survey processes?

In Model A, survey staff run reports during the survey cycle using the same data collection module into which data are entered. In Model B, survey managers and staff run reports from the cycle and frame management system used to open survey forms to respondents. Survey managers also directly query Oracle databases for additional information needed to monitor data collection. Some offices have also developed Excel spreadsheets which are automatically updated using data from the Oracle databases to monitor key survey variables. Program managers most often review reports that are summaries prepared by survey staff and survey managers that summarize these nonresponse reports.

Now that we understand both the types of data collection at EIA, and the resulting processes and systems, we can ask how data collection processes are monitored at EIA. More precisely we can explore the types of tools available for monitoring response. During the course of the listing exercise, survey staff mentioned reports that they used for nonresponse, frames management and for data quality. However, as we learned from survey methodology, monitoring nonresponse is one of the most important ways to monitor for errors in the data collection process (Groves et al., 2004). Because of this, the remainder of our analysis focuses on reports used to monitor nonresponse and aid in carrying out nonresponse follow-up.

Monitoring Nonresponse

We identified three questions that we would need to better understand the how response is monitored at EIA: What reports are used to monitor nonresponse, and what elements do these reports have in common? How are these common elements defined? Each energy program office we spoke with uses reports for monitoring nonresponse. These reports can be categorized by use: guidance on the timing of data collection; nonresponse follow up; and historical response reports. These offices also maintain schedules that assign dates by which each aspect of the survey cycle should be completed. Elements of this schedule include the survey titles, the date when the survey cycle should be opened, and guidance on when staff should follow up with nonrespondents.

Nonresponse reports in both models provide information on response and nonresponse, on contact information, and on data assurance. Elements of these reports include a list of the current nonrespondents and their contact information; and the name of the survey staff member responsible for contacting the nonrespondent. These reports are run throughout the survey cycle, but are run more frequently as the end of the collection ends for the survey collection cycle, or reference period.

A second report provides more detail on nonresponse while addressing a key challenge in nonresponse monitoring at EIA: that the response rates monitored by the survey staff are not the same as those monitored by survey managers and program office managers. This occurs in part because of the ways in which responses are recorded. In Model A, responses may be entered into the data collection module, but may not yet have been sent to the data assurance system, meaning that there are different response rates in each of these systems.

This report provides the respondent ID, the submission status of the form, and the mode of transmission of the form. Additional fields provide data specific to the data collection model. In Model A, for example, this report includes information on when the data are logged in, and the location of the data – especially a count of respondents whose data have been entered, but are not counted as respondents in the quality assurance system. In Model B, the submission status element is populated with paradata specific to internet data collection. In this model, there is an additional element not present on the nonresponse report from Model A: a weighted response rate for a key indicator being collected on the form.

Survey managers and staff also use reports to monitor historic response rates, though to a lesser degree than they use reports to monitor current cycle response rates. One nonresponse report identifies nonrespondents by year, including their establishment name, and a 12-month history of nonresponse by entity. There are few historic response rate tables that provide detailed respondent information similar to the current cycle nonresponse reports. Existing systems and reports make it difficult for survey staff to generate these detailed historic reports. Instead,

survey staff must enter the data collection system and generate reports for each survey cycle about which they are interested. After pulling each report then they must combine them to yield historic response rate report that includes detailed information about nonrespondents.

In addition to analyzing data collected during interviews to identify reports used for nonresponse, we also used the interview data to define elements of these reports. We were most interested in how response rates were defined at EIA because these rates are a very important measure of response. We needed to understand how EIA staff defined respondents, late respondents and nonrespondents, as the ability to identify these groups would figure prominently in calculating nonresponse.

Monitoring Nonresponse: Defining Response Rates and Respondents

At EIA, response rates are defined in multiple ways. One response rate is defined as the number of responses at time of publication divided by the number of eligible entities in the sampling frame. A second definition is the number of submissions divided by the number of eligible entities in the sampling frame. A third measure of response is a weighted percent of key indicator received, defined in Model B only.

The second element, equally important in monitoring response, is how program office staff at EIA define a respondent, a late respondent, and a nonrespondent. Staff have common definitions for late respondents. A late respondent is one who has not responded by the time and date defined on the survey form. There is some flexibility because of the need to receive data from large companies, regardless of timeliness. However, there is some variability in how nonrespondents are defined by survey staff. Most program offices define a nonrespondent as an entity whose data has not been provided by the time of publication. Others define a nonrespondent as an entity whose data has not been provided by the due date. Survey staff also defined problematic respondents during the course of our interviews. For the most part problematic respondents were defined as entities who are chronically late in responding, who do not respond, or who submit poor quality data repeatedly. The variation in the ways in which these elements were defined adds yet another challenge to defining a series of common metrics for use EIA-wide

Monitoring Nonresponse at EIA: Conclusions

The findings from our analysis present two challenges to developing common metrics at EIA. First of all, the elements currently being used to monitor nonresponse- response rates and counts of respondents – are not consistently defined at EIA. There is more than one definition for an on time respondent, and there are multiple definitions for a response rate. The second challenge is that these metrics require data as an input. However, the two different collection models resulted in multiple data collection processes and systems. This means that there is no one location from which to collect the data for inputs. The one fortunate outcome of our analysis is that survey staff monitoring data collection are generally use reports that consist of common elements such as respondents, their contact information, and their rates of response. However, we still needed to consistently define the metrics, and identify a common source for the data that would be used as inputs for these metrics.

Developing Prototyped Common Metrics EIA

In order to remove the variation in the definitions of response rates we arbitrarily defined two measures for monitoring response prior to calculating the prototyped metrics. We acknowledge that there are many metrics that can be used to measure response, but felt it was important to select only two measures as building blocks for the calculation of common metrics indicators at EIA. We defined one measure for response rates, and one for weighted response rates, using the following formulas:

Unweighted unit response rate = C/N

Weighted response rate = $\Sigma\omega_i y_i\, C/\Sigma\omega_i y_i N$
Where: C = the number of responding eligible units
   N = the number of eligible units
   ω_i = the sampling weight for the ith unit.
   y_i = a measure of size or a "key" variable for the ith unit.
For sample surveys N = n, the number of sampling units.
For census surveys ω_i =1 for all i.

All response rates calculated and implemented on the prototype dashboard will be defined using these formulas.

Identifying Data Sources

In order to address the challenge of identifying data sources for these metrics given the numerous data collection systems currently in operation at EIA, we developed a synthetic data set using SAS Enterprise Guide® software to be used during the development of the prototype dashboard. This has two benefits. First, it allows us to define a data set structure, data tables, and data elements in a development environment. Second, it defines requirements for the production version of the tables needed to populate a production quality dashboard. Third, it addresses the concern that these collection systems may yield different response rates by allowing us to calculate one and only one response rate for each entity.

Developing a Dashboard Prototype in SAS®

Using both these results from our analysis, and the recommendations that reflect best practices in survey monitoring metrics, we developed a series of operational data element prototypes using the SAS® Business Intelligence tool. As discussed, we first developed a set of synthetic data containing raw data on 200 entities. These data included contact information associated with each entity; response data for each entity in the past 12 months; and an arbitrary due date for each entity. We used response data for each entity to calculate a response rate following the definition provided above. We assumed that all units were eligible and that a response received after during the We also defined a value 'Total Volume' that represented the entity's total volume contributed during the current month as a percent of the total volume of product in the same reporting month of the previous year. We used this value to define quartiles, and then assigned a company size value of small, medium, or large depending on the quartile into which the entities fell. Small companies fell into the lowest quartile, medium companies fell in between the 25th and 75th percentiles, and large companies were those companies whose total volume was greater than or equal to the 75th percentile. This was a purely academic exercise and does not reflect any current EIA methodology or the values of metrics currently in use at EIA. The total volume estimates and the company size variables were also included in the synthetic data set.

Using this data set we populated the following reports: 1) a count of response and nonresponse for the current survey period; 2) detailed contact information for entities who have not responded, including the entity name; contact name; contact phone number and a contact e-mail address; 3) a trend line showing the response rate for the past twelve months; 4) a count of response and nonresponse, including detailed contact information, for the past 12 months; 5) a count of response and nonresponse broken out by company size as a placeholder for a weighted response rate. Each report is actually a graphic indicator of the statistic, and so we refer to them as indicators. These indicators were developed using SAS Enterprise Guide® software and SAS® Enterprise BI Server components. (See Appendix B for the indicator prototypes.) This is the extent of the development work that has been completed, but the process of development continues at EIA. While we are encouraged by the early development steps, we acknowledge that there is still much work to be done. In future steps we will need to address layout and dashboard design, and then test the dashboard design with program offices. We will also need to document the dashboard system and the indicators so that the system can be deployed and enhanced as needed in the future.

Conclusion

EIA has disparate data collection systems, data collection methods, and data collection monitoring across energy groups. This makes it challenging to monitor survey processes in a similar manner across all of these energy groups.

We argue that the development of dashboard prototype is a feasible strategy for unifying the survey monitoring practices at EIA. In so doing, we demonstrate a process that includes qualitative research into data collection methods, systems, and survey monitoring processes. We also demonstrate that when these research results are combined with metrics designed to monitor response such as response rates and weighted response rates, the result is a dashboard prototype that accommodates the needs of the program managers, survey managers and survey staff while unifying the ways in which these staff members monitor nonresponse. We hope in the future to use experience gained during the remainder of the development process as a basis for further research. We also plan to discuss the lessons we have learned from usability testing and how we have used results from this testing to as improve the dashboard's aesthetic. We hope our future research will aid others in developing a useful and practical dashboard for use in establishment surveys.

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Appendix A: Topic Guide – Administrative data reports at EIA

Research Objectives

- Identify how survey managers and contractors monitor their surveys and survey processes

- Determine how survey managers and contractors use administrative data as part of the survey review process

- Identify key report features used in frame maintenance and response rate monitoring;

- Develop list of features that can be added and features that should be removed from current reports;

- Document any threats to successful data collection and determine if the risk can be mitigated by information.

Population of Interest

- EIA staff members who utilize existing reports or data generated automatically by a reporting system (such as CUFS, or the DCM) for maintaining frames of monthly surveys.

- Four levels of responsibility:

  o Team leads (Separate topic guide to be developed)

  o Survey managers

  o Contractors

  o Directors (not interviewed)

- Representatives from most of the energy groups (Electric; Oil; Natural Gas; Alternative Fuels; Nuclear; Coal /Natural Gas, etc.)

Before the Interview

- Review the project charter for goals of focus group

- Review monthly surveys that each participant works on/with

Materials Needed

- Large writing pad for listing exercise

- Paper/pen

- Note paper

- Hard Candy

Length of Interview

- 90 minutes

Part A: Introduction (5 minutes)

    A.   Moderator Introduction

Topic of Interest: The Survey Development Team (SDT) is trying to learn about the reports EIA uses to monitor the survey collection process. As a part of this research process, I am meeting with monthly survey managers and analysts from each energy group to learn more about the information used to monitor the survey cycle and data collected. I'd also like to learn more about which EIA systems are used to monitor the survey cycle and data collected. I intend to develop new prototypes of survey output based on what I learn from you. I understand that in the past there have been varying degrees of resources available to offices for the development of survey reports to oversee survey processes. I came from an agency with less money than EIA, so I understand how limited resources can act as a detriment to development of efficient and useful systems. I think that the survey managers at EIA may have some common needs and I am hoping to develop a set of reports that will address those common needs. To me this means that these reports incorporate the information that you provide in these meetings, provide relevant information, and are the best that we can develop given our resource constraints. In the interest of full disclosure, I also want to let you know that eventually I will be sharing these prototype reports with the directors. The directors here acknowledge that the technology at EIA is outdated, and that reports are not consistent across all of the offices. What is good is that the directors understand that they can't tell me what you all need. I need to understand from your perspective what you need to manage surveys, so I'm starting the conversations with you first. With that in mind, let's get started.

    B.   Rules of the focus group

        a.   Informal group discussion, participation is encouraged

        b.   Promise of anonymity

        c.   All opinions count

        d.   Encourage constructive disagreement

        e.   Emphasize the number of topics to be covered –stay on topic

Part B: How do you monitor the monthly surveys? (15 minutes)

    A.   Listing exercises:

        a.   Which elements of the survey process do you oversee? (Examples include frame maintenance, births/deaths, nonresponse, QA/QC1, etc.)

        b.   Are there certain times during the survey cycle that you review information on specific elements of the survey process?

            i.   Tell me more about what you review when you are overseeing a survey – do you look at top-level reports, specific data points, or something else?

           ii.   Can you tell me about a time when you used this information to help you to anticipate a problem with your data?

          iii.   Tell me more about what aspects of this information you used to identify the issue.

          iv.   What have you done in the past when you have identified a problem?

Part C: Do you currently have administrative reports to monitor your survey? (15 minutes)

    A.   Frame maintenance/response rates

        a.   In general, how do you assess data quality?

b. How do you assess the quality of your survey's frame?

c. How do you assess the quality of your survey's response rates?

d. Which reports do you use to tell you about the quality of your survey frame?
What about response rates?

e. Give me an example of how you might use a report to determine the quality of your frame.

f. Can you give me an example of a report that you might use to assess the quality of your response rates?

g. What format do these reports come in? (Excel, PDF, etc.)

h. Walk me through the steps that you take to get information on the quality of your survey frames and response rates.

Part D: How are you using administrative reports to maintain frames for your survey? (15 minutes)

Thinking specifically about the information that you described above to tell you about the quality of your survey frame:

A. At what level is information provided? (Survey level, respondent level, other?)

B. What types of information are available to you?

    a. Do you have a way to look at the entire frame?

    b. Give me an example of how you have used frame information in the past to identify new companies that are responding or should be responding to your survey.

    c. Tell me how you might use this information to identify a death in the frame or an establishment that should be removed from the frame.

    d. Are there times when you have to use multiple reports to perform a single task?

    e. If so, are these reports pulled from more than one system?

    f. Tell me a little bit more about how you compile these reports.

C. When during the survey cycle do you look at this information?

    a. Which information do you look at frequently to manage your frame?

    b. How many times would you say you look at this information per week?

    c. Do you look at information from different reports?

    d. Which information don't you look at? Why not?

    e. Which information is available that you would like to look at, but do not have the time to?

D. Do you also provide reports to others?

    a. If so, who?

    b. What kinds of reports do you need to give them?

    c.   Do these reports require you to combine information from different systems as well?

    d.   Do you provide these reports at a certain time during the survey cycle?

    e.   Tell me more about the requests that you are given for reports about the survey.

E.   Can you tell me about a time when you looked at one (or more than one) of these reports and you just knew that something was wrong?

    a.   What information did you use to tip you off?

    b.   What did you do with the information?

    c.   Who did you report the problem to?

    d.   What was the outcome?

Part E: How are you using administrative reports to monitor response rates? (30 minutes)

Thinking specifically about reviewing response rates and the timeliness of respondents:

A.   At what level are response rates provided? (Survey level, respondent level, other?)

B.   What types of information are available to you?

    a.   Do you review information for the survey as a whole, for respondents as a whole, or for specific establishments only?

    b.   Do response rates reports provide response rates over the course of a week? A month?

    c.   Do response rates reports provide you information about responses as of a certain date – say the due date, for example?

    d.   What other information is provided on these reports? Can you give me examples of what types of information might be on a response rate report?

C.   How many reports on response rates do you review for monthly surveys?

    a.   Which reports do you look at most often?

    b.   What would you look at if you had more time to do so?

    c.   What don't you look at? Why not?

    d.   Are there times when you have to use multiple response rates reports to perform a single task?

    e.   If so, are these reports pulled from more than one system?

    f.   Tell me a little bit more about how you compile these reports.

D.   When during the survey cycle do you look at this information?

    a.   Tell me about specific points during the cycle that you look at response rates? (Probe: Survey due date?

    b.   How many times would you say you look at this information per week?

    c.   Do you look at information from different reports more than once during the cycle?

E. Do you also provide reports on response rates to others?

    a. If so, to whom are you providing them?

    b. What kinds of reports do you need to give them?

    c. Do these reports require you to combine information from different systems as well?

    d. Do you provide these reports at a certain time during the survey cycle?

    e. Tell me more about the requests that you are given for reports about the survey's response rates.

Now thinking about administration reports that you review for response rates for the survey as a whole (if relevant):

A. What statistics do you use to indicate the overall response to the surveys?

B. Can you look at survey response over the course of a week (E.g. response on Monday, response on Tuesday) in one place?

C. Can you look at the mode of response for each survey?

D. Are you provided with the percent of total product that each survey has collected?

E. Is there some way that you have to access this information in real time (e.g. when you retrieve the information it is current as of the time you pulled it, rather than of the day before.)

F. Give me an example of a time when you have used response rates to identify an issue with a survey's responses.

G. Tell me about a time when you needed to change the way that this information was reported to you or get more information than was currently available? What did you do?

Now thinking about the data that you review for response rates for an establishment: (if relevant):

A. What do you use to indicate the establishment's response to the surveys?

B. How do you review this information– can you look at how an establishment responded over the course of a week (E.g. response on Monday, response on Tuesday) in one place?

C. Does the information tell you about the mode of response for each establishment?

D. Are you provided with the percent of total product that each establishment has reported?

E. Tell me more about how these percents are calculated.

F. Are the reports provided in real time?

G. Give me an example of a time when you have used this information to identify an issue with a survey's responses.

H. Tell me about a time when you needed to get more information than was currently available. What did you do?

Now thinking about the respondents themselves:

A. Are there establishments that are consistently late in responding to your surveys?

B. How do you define consistently late?

C. If you had only three dates or times available to review response rates in order to identify establishments who are consistently late during the survey cycle, which dates would these be? (For example, the survey's due date, date that data are required for publication date, some midpoint between the two?)

D. At what points during the survey cycle do you contact respondents who have not yet responded?

Part E: Accessibility of current Administrative reports (10 minutes)

A. Frame maintenance/response rates

    a. Again thinking about the frame and response rate information, if you did not know anything about your respondents – if you were brand new to EIA, what kind of information would you find confusing? What would you like clarified?

Part F: Wrap Up (5 minutes)

A. Can you provide me with examples of data that you use frequently during the survey management process? (Screen shots are okay.)

B. Next steps.

**Appendix B: Indicator Descriptions and Images**

Indicator 1: Response Rate, Current Survey Cycle

- This indicator provides the unweighted response rate by the due date on the form for the eligible reporting entities in the sample. This rate is calculated using response data from the synthetic raw data set described in the article and does not reflect current EIA response rates or methodology.

- The indicator also includes a range of acceptable response rates. The range of the indicator provides three measures: below target (indicated by red on the thermometer); on target (yellow) or above target (green). The height of the fill line in the thermometer is a visual clue to the viewer of the current response rate.

- For this indicator, the ranges are set so that a response rate between 0 and 80 percent is below target; a response rate between 80 percent and 100 percent is on target, and above 100 percent is above target. The target rate of 80 percent is chosen as a reminder to survey managers that it may be necessary to conduct an analysis of nonresponse bias. The Office of Management and Budget strongly encourages surveys with unweighted response rates below 80 percent to conduct an analysis of nonresponse bias in those surveys (Office of Management and Budget 2006).

- The title of the indicator reflects the survey cycle, or reporting period. In this case the reporting period is December 2012. The numerical value of the response rate is at the base of the thermometer.
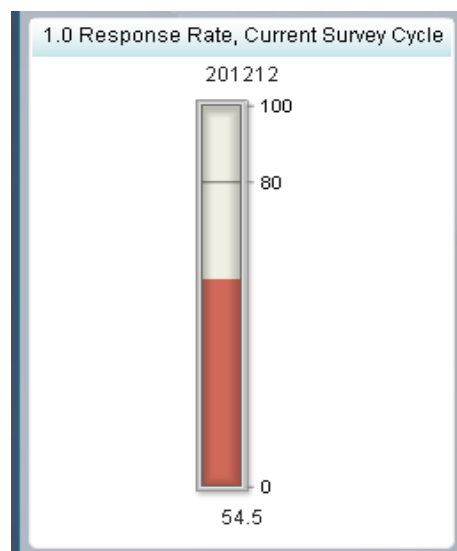
Indicator 2: Historic Response Rate

- This indicator provides a twelve-month trend line showing the unweighted response rate by the due date on the form for the eligible reporting entities in the sample. These rates are calculated using response data from the synthetic raw data set described in the article and do not reflect current EIA response rates or methodology.

- Similar to the indicator showing the unweighted response rate for the current collection cycle, the indicator also includes a range of acceptable response rates, shown by three lines on the indicator itself. The range of the indicator provides three measures: below target (indicated by red on the thermometer); on target (yellow) or above target (green).

- For this indicator, the ranges are set so that a response rate between 0 and 0.8 (or 80) percent is below target; a response rate between 80 percent and 100 percent is on target, and above 100 percent is above target. The target rate of 80 percent is chosen as a reminder to survey managers that it may be necessary to conduct an analysis of nonresponse bias. The Office of Management and Budget strongly encourages surveys with unweighted response rates below 80 percent to conduct an analysis of nonresponse bias in those surveys (Office of Management and Budget 2006).
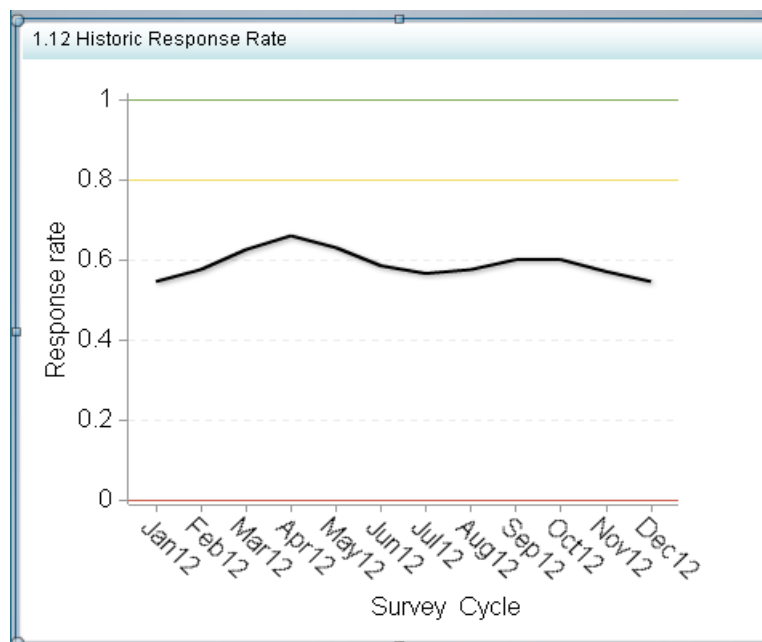
Indicator 3: Count of Response and Nonresponse, Current Survey Cycle

- This indicator provides a count of the number of respondents and nonrespondents for the current survey cycle period. The number of respondents and nonrespondents will be counted based on the number of responses received by the survey form due date. Nonrespondents are those entities who are eligible to report and who did not do so by the close of the survey reporting period.

- The indicator is a bar chart, with a bar for the current reporting period showing a count of responses and nonresponses at the time the form was due.

- Associated with this indicator will be a table providing a list of nonrespondents, their EIA ID, and the contact information (name, phone, e-mail) for the primary survey contact. A measure of company size will be included in the detailed table.
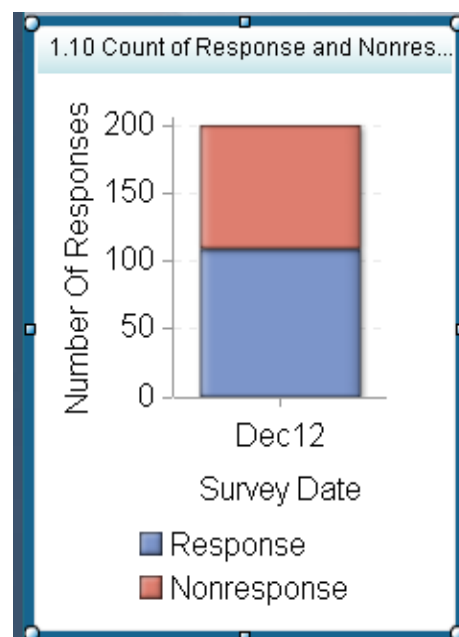
Indicator 4: Count of Response and Nonresponse, 12 months

- This indicator provides a count of the number of respondents and nonrespondents for the current survey cycle period (denoted as survey date in the picture below) as well as the past 11 reporting periods. The number of respondents and nonrespondents will be counted based on the number of responses received by eligible entities on the survey form due date.

- The indicator will be a bar chart, with a bar for each of the previous reporting periods showing a count of responses and nonresponses at the time the form was due.

- Associated with this indicator will be a table providing a list of nonrespondents for the reporting period referenced, their EIA ID, and the contact information (name, phone, e-mail) for the primary survey contact. A measure of company size will be included in the detailed table.

Indicator 5: Response Rate, by Company Size, Current Survey Cycle

- This indicator provides a response rate by entity size class. There will be three indicators – one for small, medium, and large entities respectively.

- The indicator includes a range for percent of response by company size. The range of the indicator provides three measures: below target (indicated by red on the thermometer); on target (yellow) or above target (green). Following similar practice to the response rate indicators above, the target ranges are as follows: 0 percent to 80 percent, below target 80 percent to 100 percent: on target; and above 100 percent: above target. In production these range values will be adjusted to reflect the survey being monitored. This indicator is composed of three thermometers, each of which represents a category for company size. Company size is defined based on the contribution of each company to the sample estimate "total volume" which was included in the synthetic raw data set. We defined quartiles for total volume based on the assumption of a normal distribution. We then assigned a company size value of small, medium, or large depending on the quartile into which the entities' reported total volume fell. Small companies fell into the lowest quartile, medium companies fell in between the 25th and 75th percentiles, and large companies were those companies whose total volume was greater than or equal to the 75th percentile. Using the response data for each company, by their size classification, we calculated response rates by class.

- This indicator serves as a placeholder for weighted response rates, as these rates will be unique to the key data point of interest.