B. Collection of information employing statistical methods.
The statistical methods used in the sample design of the survey are described in this section. The documents listed below are included in this package and are either referenced in this Part or provide additional information.

Overview of the Survey of Occupational Injuries and Illnesses Sample Design and Estimation Methodology – Presented at the 2008 Joint Statistical Meetings (10/27/08)-- ***http://www.bls.gov/osmr/pdf/st080120.pdf***

Deriving Inputs for the Allocation of State Samples (05/01/13)

The growth in cases with Restricted Activity or Job Transfer (08/2011)

Methods Used To Calculate the Variances of the OSHS Case and Demographic Estimates (2/22/02)

Variance Estimation Requirements for Summary Totals and Rates for the Annual Survey of Occupational Injuries and Illnesses (6/23/05)

BLS Handbook of Methods – Occupational Safety and Health Statistics (September 2008) -- ***http://www.bls.gov/opub/hom/pdf/homch9.pdf***

1. Description of universe and sample.

Universe

The main source for the SOII sampling frame is the BLS Quarterly Census of Employment and Wages (QCEW) (*BLS Handbook of Methods*, Chapter 5 from http://www.bls.gov/opub/hom/homch5_a.htm). The QCEW is a near quarterly census of employers collecting employment and wages by ownership, county, and six-digit North American Industry Classification System (NAICS) code. States have an option to either use the QCEW or supply public sector sampling frames for State and local government units. In SY2012-SY2014 six states provided their own local government frames and seven provided their own state government frames.
The potential number of respondents (establishments) covered by the scope of the survey is approximately 7.6 million, although only about 1 million employers keep records on a routine basis due to recordkeeping exemptions defined by OSHA for employers in low hazard industries and employers with less than 11 employees, or having no recordable cases. The occupational injury and illness data reported through the annual survey are based on records that employers in the following North American Industry

Classification System (NAICS) industries maintain under the Occupational Safety and Health Act:

Sector	Description
11	Forestry, Fishing, and Hunting
21	Mining
22	Utilities
23	Construction
31, 32, 33	Manufacturing
42	Wholesale Trade
44,45	Retail Trade
48,49	Transportation and Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Services (except Public Administration)

Excluded from the national survey collection are:

- Self-employed individuals;
- Farms with fewer than 11 employees (Sector 11);
- Employers regulated by other Federal safety and health laws;
- United States Postal Service and;
- Federal government agencies.

Mining and Railroad industries are not covered as part of the sampling process. The injury and illness data from these industries are furnished directly from the Mine Safety and Health Administration and the Federal Railroad Administration, respectively, and used to produce State and national level estimates

Data collected for reference year 2008 and published in calendar year 2009 marked the first time State and local government agency data were collected for all States and published for all States and the nation as a whole.

The SOII is a Federal/State cooperative program, in which the Federal government and participating States share the costs of participating State data collection activities. State participation in the survey may vary by year. Sample sizes are determined by the participating States based on budget constraints and independent samples are selected for each State

annually. Data are collected by BLS regional offices for non-participating States.

For the 2013 survey, 42 states plus the District of Columbia plan to participate in the survey. For the remaining eight states which are referred to as Non-State Grantees (NSG), a smaller sample is selected to provide data which contribute to national estimates only.

The eight NSG States for 2013 are:

Colorado	Florida	Idaho
Mississippi	New Hampshire	North Dakota
Rhode Island	South Dakota	

Starting in survey year 2011, Florida opted not to participate in the survey and became an NSG state. In addition, three states (Massachusetts, Pennsylvania, and Ohio) chose to participate in the survey. Pennsylvania joined starting in 2011; Massachusetts and Ohio joined in 2012.

Additionally, estimates are tabulated for three U.S. territories-Guam, Puerto Rico, and the Virgin Islands-but data from these territories are not included in the tabulation of national estimates.

Sample

The SOII utilizes a stratified probability sample design with strata defined by State, ownership, industry, and size class. The first characteristic enables all the State grantees participating in the survey to produce estimates at the State level. Ownership is defined into three categories: State government, local government, and private industry. There are varying degrees of industry stratification levels within each State. This is desirable because some industries are more prevalent in some States compared to others. Also, some industries can be relatively small in employment but have high injury and illness rates which make them likely to be designated for estimation. Thus, States determine which industries are most important in terms of publication and the extent of industry stratification is set independently within each State. BLS sets some minimal levels of desired industry publication to ensure sufficient coverage for national estimates. So the state levels can only be set at an industry detail that is more specific than those set by BLS. These industry classifications are defined using the North American Industry Classification System (NAICS, http://www.census.gov/eos/www/naics/)and are referred to as Target Estimation Industries (TEI The industry classifications set by the national office are referred to as NTEI, and are not used as sampling strata.

Finally, establishments are classified into five size classes based on average annual employment and defined as follows:

Size Class	Average Annual Employment
1	10 or less
2	11-49
3	50-249
4	250-999
5	1000 or greater

After each establishment is assigned to its respective stratum, a systematic selection with equal probability is used to select a sample from each sampling cell (stratum). As mentioned earlier, a sampling cell is defined as State/ownership/TEI/size class. Prior to sample selection, units within a sampling cell are sorted by employment and then by Reporting Unit number (a unique identifier assigned to each reporting unit on the QCEW) to ensure a consistent representation of all employments in each stratum. Full details of the survey design are provided in Section 2.

For survey year 2013, the sample size will be approximately 240,000 or three percent of the total 7.6 million establishments in State, local, and private ownerships.

Response rate. The survey is a mandatory survey, with the exception of State and local government units in the States listed below:

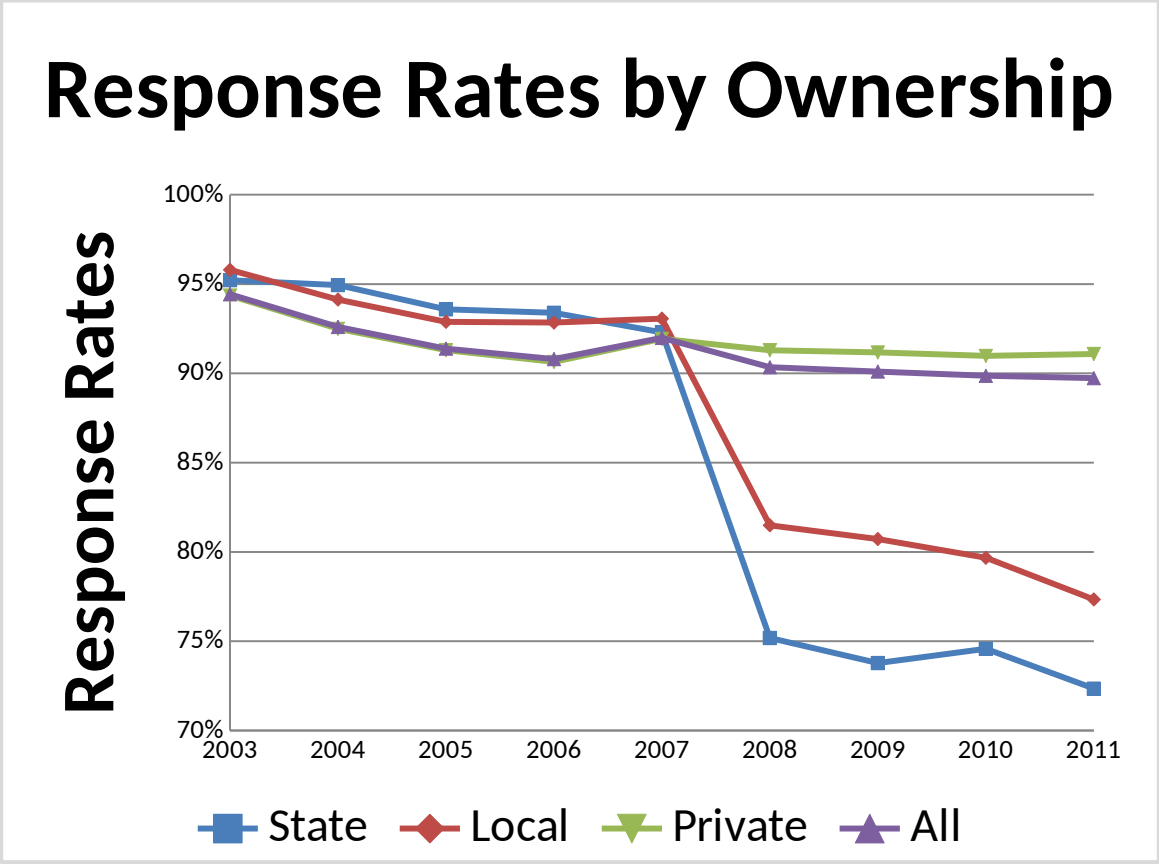
Alabama	Arkansas	Colorado	Delaware
District of Columbia	Florida	Georgia	Idaho
Illinois	Kansas	Louisiana	Mississippi
Missouri	Montana	Nebraska	New Hampshire
North Dakota	Ohio	Pennsylvania	Rhode Island
South Dakota	Texas		

Each year, respondents in the SOII survey are notified of their requirement to participate via mail. All non-respondents are sent up to two non-response mailings as a follow-up to the initial mailing. Some States choose to send a third non-response mailing to non-respondents late in the collection period. For Survey Year 2011, approximately half of the States sent an optional third non-response mailing to a majority of the non-respondents at that point in time. In addition, States may contact respondents via telephone for additional non-response follow-up. No systematic establishment level data on the number of telephone non-response follow-up contacts is captured.

As mentioned earlier, public sector establishments were included in the 2008 survey for **all** States, including those from which no public sector data had been collected in the past. In these states, public sector establishments have no mandate to provide data to the SOII; their participation is voluntary. For survey year 2008, the rates for both State and Local government decreased, primarily due to the addition of the voluntary State and Local government establishments.

In 2010 an in-depth response rate analysis was undertaken. Aggregate response rates in the SOII were shown to be above 90% due to the mandatory nature of the survey and the excellent efforts to obtain survey data by our State and Regional partners. However, it was also shown that response rates in states with voluntary reporting status for the State and local governments had low response rates for the government units. It is in this case that non-response bias is currently being studied. In subsequent years, this study was updated to continually monitor the item and establishment non-response. As of the most recent update, there have been no significant changes.

The table below illustrates the establishment level response rates from 2003-2011:



Although response rates for the SOII program have historically been high, the expansion of public sector collection in voluntary States resulted in a response rate of 75 percent in State government in 2008. Per OMB statistical guidelines, a nonresponse bias study has been initiated. This work currently includes analysis of characteristics of respondents compared to non-respondents using sampling frame variables such as NAICS industry, employment size class, and ownership category (i.e. State government vs. Local government). This analysis employs a logistic regression model which hopes to predict which units are likely or not likely to respond to the survey. After predicting whether the establishment responds, the two groups (likely respondents and likely non-respondents) will be compared in order to quantify any bias that may be present. As the current analysis effort is completed, the specifics of the multivariate analysis will be specified more completely.

Additional response efforts are being conducted to analyze response rates for several key data elements collected for each establishment in the survey. Data elements for NAICS industry, SOC occupation, source, nature, part, and event for each case with days away from work are coded by BLS regional staff and/or State partners. As such, these fields are always available for collected data. Other data elements such as ethnicity, whether the event occurred before/during/after the work shift, the time of the event, and the time the employee began work may be missing from collected data. We have initiated a response analysis effort for these other data elements to identify our specific response rates and the characteristics of respondents versus non-respondents for these variables.

Regional offices are also working with States on collection practices to improve response for voluntary units.

We will continue to monitor the response rates in the next 3 years for all segments of the survey scope. We will update the analysis each year and make recommendations for improvements in the data collection process based on the results of our analysis. If response rates at the establishment level remain below 80% for any group of establishments, we will conduct additional non-response bias studies. If response rates for any specific data element within establishments are below 70%, we will also implement additional non-response bias studies. Details for these studies will be documented as the studies begin.

2. Statistical methodology.

Survey design. The survey is based on probability survey design theory and methodology at both the national and State levels. This methodology provides a statistical foundation for drawing inference to the full universe being studied.

Research was done to determine what measure of size was most appropriate for the allocation module. Discussion with OSHS Management narrowed the choices to the incidence rates. That is: the rate (in 100,000 worker hours) in which cases had an incidence of injury or illness for Total Recordable Cases (TRC); Cases with Days Away from Work (DAFW); and Cases with Days Away from Work, Job Transfer, or Restriction (DART).

Incidence rates from the 2003 SOII were studied for all 1251 TEIs for each of the above case categories. Given the likelihood that the incidence rate on the total recordable cases would most closely track the incidence of injury and illness when compared to the alternatives, the incidence rate on the total recordable cases was chosen for the measure of size.

Additionally, to fulfill the needs of users of the survey statistics, the sample provides industry estimates. A list of the industries for which estimates are required is compiled by the BLS after consultation with the principal Federal users. The sample is currently designed to generate national data for all targeted NAICS levels that meet publication standards.

Allocation procedure. The principal feature of the survey's probability sample design is its use of stratified random sampling with Neyman allocation. The characteristics used to stratify the units are State, ownership (whether private or state or local government), industry code, and employment size class. Since these characteristics are highly correlated with the characteristics that the survey measures, stratified sampling provides a gain in precision and thus results in a smaller sample size.

Using Neyman allocation, optimal sample sizes are determined for each stratum within each State. Historical case data are applied to compute sampling errors used in the allocation process. Details about this process can be found in ***Deriving Inputs for the Allocation of State Samples*** (05/01/13).

The first simplifying assumption for allocation is that for each TEI $\times$ size class stratum h, the employment in each establishment is the same, which is denoted by E_h. We also ignore weighting adjustments. In addition, we assume that the sampling of establishments in each stratum is simple random sample with replacement. (It is actually without replacement of course, but this is a common assumption to simplify the formulas.)

One consequence of these assumptions is that the estimate of the overall employment is constant and as a result the estimated

incidence rate of recordable cases in the universe is the estimated number of recordable cases divided by this constant. Therefore, the optimal allocation for the total number of recordable cases and the incidence rate of recordable cases are the same. We will only consider the optimal allocation for the total number of recordable cases.

We introduce the following notation. For sampling stratum *h* let:

N_h denote the number of frame units

n_h denote the number of sample units

$W_h = N_h / n_h$ denote the sample weight

$T_h = N_h E_h$ denote the total employment in stratum *h*

p_h denote the incident rate for total recordable cases

$\hat{Y}_h$ denote the unweighted sample number of recordable cases

Also let:

$\hat{Y}$ denote the estimated number of recordable cases in the entire universe.

Then

$$\hat{Y} = \sum_h W_h \hat{Y}_h = \sum_h \frac{N_h \hat{Y}_h}{n_h} \tag{1}$$

$$V(\hat{Y}) = \sum_h \frac{N_h^2 V(\hat{Y}_h)}{n_h^2} \tag{2}$$

where *V* denotes variance.

Now we will obtain $V(\hat{Y}_h)$ under two different assumptions. Assumption (a) is:

(a) All employees in stratum *h* have either 0 or 1 recordable cases and the probability that an employee has a recordable case is p_h .

In this case $\hat{Y}_h$ can be considered to have a binomial distribution with $n_h E_h$ trials and p_h the probability of success in each trial and consequently

$$V(\hat{Y}_h)=n_h E_h p_h(1-p_h) \tag{3}$$

Assumption (b) is:

(b) The total recordable case rate Y_h for the n_h sample establishments in stratum *h* has E_h times a binomial random variable with n_h trials and p_h the probability of success in each trial. In that case

$$V(\hat{Y}_h)=n_h E_h^2 p_h(1-p_h) \tag{4}$$

Although we will derive the optimal allocations under both assumptions, we prefer assumption (b) since assumption (a) presumes that each employee's exposure is independent of every other employee within the establishment. This is likely understating the variance. Assumption (b) by contrast, is assuming that every employee within the establishment is injured with probability, p_h, which is likely overstating the variance. We chose assumption (b) to apply the Neyman allocation.
To derive the optimal allocation under assumption (a) we substitute (3) into (2) obtaining

$$V(\hat{Y})=\sum_h \frac{N_h^2 E_h p_h(1-p_h)}{n_h} \tag{5}$$

Viewing (5) as a function of the variables n_h and minimizing (5) with respect to these variables by means of the method of Lagrange multipliers, we obtain that (5) is minimized when the n_h are proportional to

$$N_h(E_h * p_h * (1-p_h))^{.5} \tag{6}$$

As for the preferred assumption (b), to derive the optimal allocation, we similarly substitute (4) into (2) obtaining

$$V(\hat{Y})=\sum_h \frac{N_h^2 E_h^2 p_h(1-p_h)}{n_h} \tag{7}$$

Minimizing (7) as we minimized (5), we obtain that (7) is minimized when the n_h are proportional to

$$N_h * E_h * (p_h(1-p_h))^{.5} = T_h(p_h(1-p_h))^{.5} \quad (8)$$

which is the preferred allocation.

Sample procedure. Once the sample is allocated, the process of selecting the specific units is done by applying a systematic selection with equal probability independently within each sampling cell. Because the frame is stratified by employment size, and the choice of variance estimator overstates the variance in large establishments, we are implicitly oversampling the strata in a manner that is similar to PPS sampling by the size of the establishment. So it was felt that no additional value would be gained by selecting the sample by PPS.

The survey is conducted by mail questionnaire through the BLS-Washington and Regional Offices and participating State statistical grant agencies. Respondents are able to provide responses to the survey via the internet, an Adobe fillable form, or by submitting data via a paper questionnaire. In a limited number of cases, data is collected by participating State statistical grant agencies or BLS Regional Office employees through telephone conversations with respondents.

Estimation procedure. The survey's estimates of the number of injuries and illnesses for the population are based on the Horvitz-Thompson estimator, which is an unbiased estimator. The estimates of the incidence of injuries or illnesses per 100 full-time workers are computed using a ratio estimator. The estimates of the incidence rates are calculated as

$$R = C\left(\frac{200{,}000}{\sum H}\right)$$

where:

C = number of injuries and illnesses
$\sum H$ = total hours worked by all employees during a calendar year
200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

The estimation system has several major components that are used to generate summary estimates. The first four components generate factors that are applied to each unit’s original weight

in order to determine a final weight for the unit. These factors were developed to handle various data collection issues. The original weight that each unit is assigned at the time the sample is drawn is multiplied by each of the factors calculated by the estimation system to obtain the final weight for each establishment. The following is a synopsis of these four components.

When a unit cannot be collected as assigned, it is assigned a **Reaggregation** factor. For example, if XYZ Company exists on the sample with 1000 employees but the respondent reports for only one of two locations with 500 employees each, it is treated as a reaggregation situation. The Reaggregation factor is equal to the target (or sampled) employment for the establishment divided by the reported employment for collected establishments. It is calculated for each individual establishment.

In cases where a sampled unit is within scope of the survey but does not provide data, it is treated as a nonrespondent. Units within scope are considered viable units. This would include collected units as well nonrespondents. The **Nonresponse** adjustment factor is the sum of the weighted viable employment within the sampling stratum divided by the sum of the weighted usable employment for an entire sampling stratum. The nonresponse adjustment factor is applied to each unit in a stratum.

In some cases, collected data is so extreme that it stands apart from the rest of the observations. For example, suppose in a dental office (which is historically a low incidence industry for injuries and illnesses), poisonous gas gets in the ventilation system which causes several employees to miss work for several days. This is a highly unusual circumstance for that industry. This situation would be deemed an outlier for estimation purposes and handled with the outlier adjustment. If any outliers are identified and approved by the national office, the system calculates an **Outlier** adjustment factor so that the outlier represents only itself. In addition, the system calculates outlier adjustment factors for all other non-outlier units in the sampling stratum. This ensures that the re-assigned weight is distributed equally amongst all units in the strata.

Benchmarking is done in an effort to account for the time lapse between the sampling frame used for selecting the sample and the latest available frame information. Thus, a factor is computed by dividing the target employment (latest available employment) for

the sampling frame by the weighted reported employment for collected units.

The system calculates a final weight for each unit. The final weight is a product of the original weight and all four of the factors. All estimates are the sum of the weighted (final weight) characteristic of all the units in a stratum.

In 2010 a pilot study to measure rates of Days of Job Transfer or Restriction (DJTR) for selected industries was begun using data from the 2011 survey reference year. The first public release of the case and circumstances data for DJTR cases from this pilot occurred on April 25, 2013. BLS is analyzing the results of this test to determine the value of the information and is looking at how best to implement the collection of these data as well as days away from work cases in future survey years.

3. Statistical reliability.

Survey sampling errors.

The survey utilizes a full probability survey design that makes it possible to determine the reliability of the survey estimates. Standard errors are produced for all injury and illness counts and case and demographic data as well for all data directly collected by the survey.

The variance estimation procedures are described in detail in the attached documents mentioned earlier:

Methods Used To Calculate the Variances of the OSHS Case and Demographic Estimates (2/22/02)
Variance Estimation Requirements for Summary Totals and Rates for the Annual Survey of Occupational Injuries and Illnesses (6/23/05)

4. Testing procedures.

The survey was first undertaken in 1972 with a sample size of approximately 650,000. Since then the BLS has made significant progress toward reducing respondent burden by employing various statistical survey design techniques; the present sample size is approximately 240,000. The BLS is continually researching methods that will reduce the respondent burden without jeopardizing the reliability of the estimates.

Responding to concerns of data users and recommendations of the National Academy of Sciences, in 1989, the BLS initiated its efforts to redesign the survey by conducting a series of pilot

surveys to test alternative data collection forms and procedures. Successive phases of pilot testing continued through 1990 and 1991. Cognitive testing of that survey questionnaire with sample respondents was conducted at that time. The objective of these tests was to help develop forms and questions that respondents easily understand and can readily answer.

In survey year 2006, the SOII program conducted a one-year quality assurance (QA) study that had primarily a focus on addressing the magnitude of employer error in recording data from their OSHA forms to the different types of BLS collection forms and methods. The results showed no systematic under-reporting or over-reporting by employers. There was no strong dependence between error rates and collection methods.

Beginning in survey year 2007, the QA program introduced in 2006 was extended and modified to evaluate the quality of the data collected in terms of proper collection methods with the goal of minimizing curbstoning and collector adjustments without respondent contact. If improper collection methods or procedures were uncovered, they were corrected. A byproduct of this program was that each data collector would know that any form they have processed could be selected for the program.

In 2003, the BLS introduced the Internet Data Collection Facility (IDCF) as an alternative to paper collection of data. This system has edits built in which help minimize coding errors. The system is updated annually to incorporate improvements as a result of experience from previous years.

In 2008, extensive cognitive testing was completed on the IDCF collection system. In addition to being an overall review, this testing also provided detailed analysis of the site’s usability and eye-tracking. The summary (Summary of Expert Review of SOII IDCF Web Pages) provided extensive feedback, as well as a rating system that addressed “short-term” (wording changes), “Mid-term” (changes that affect the order of pages (flow), but seemed simple to execute), and “long-term” (changes with skip patterns, or associated buttons that appear to be more complex and would require more testing). The implementation of these changes went through a prioritization processes that took into account BLS staff resources to implement.

In 2009, extensive cognitive testing was completed on the IDCF Adobe Fillable Form. Recommendations were provided (OSMR Review of the Revised SOII Adobe Form), and efforts were made to incorporate them in a timely manner.

In 2012, extensive follow-up cognitive testing was completed on the IDCF collection system. This testing showed (Results of the

SOII Edits Usability Test) a vast improvement over previous studies, and noted limited issues in three main areas:

1) Respondents showed difficulty in understanding what they are supposed to enter in the 'total hours worked by all employees' field, and in using the optional worksheet that accompanies this field.
2) Respondents can be confused and/or frustrated by the way the information about the average hours worked per employee is derived and presented on the screen.
3) Respondents can miss or have negative reactions to the error message that appears on the detailed “cases with days away from work” reporting page.

Currently these issues are being prioritized for future implementation based on the level of perceived need and available resource constraints.

Since 2009, BLS and other agencies have conducted research regarding the completeness of SOII estimates. The Government Accountability Office conducted an audit of employers’ OSHA logs to determine factors that may influence recordkeeping accuracy and a study of the prevalence of employers’ safety incentive programs. BLS compared selected SOII case reports to worker’s compensation claims, initially for one state, and then expanded this effort to additional states through agreements with an academic researcher and two State Agency Grantees. This was part of a SOII research program that also included an evaluation of using multiple data sources to enumerate two specific kinds of injuries and qualitative interviews of SOII respondents to better understand employer practices in recordkeeping, SOII reporting, and filing workers’ compensation claims. BLS has begun a new round of research with State Agency Grantees to obtain quantitative estimates of employer recordkeeping practices and to match SOII cases to worker’s compensation claims for a twelve-year period. Results from these research efforts could lead to future data quality studies on completeness of data at the state and national levels.

During an examination into the causes the high instance of ‘unpublishable’ estimates (i.e. estimates that for various reasons were deemed to be too volatile, or in violation of confidentiality agreements), it was discovered that some sampling strata exhibit a high degree of ‘sampling inefficiency’ (i.e. items sampled not being useable for estimation for any number of reasons). In 2013, a research project began to determine if it would be feasible to ‘oversample’ these strata in a way that would minimally impact the optimal sizes produced by the Neyman allocation. This research is currently ongoing.

The BLS also utilizes statistical quality control techniques to maintain the system's high level of reliability.

5. Statistical responsibility.

The Statistical Methods Group, Chief, Gwyn Ferguson is responsible for the sample design which includes selection and estimation. Her telephone number is 202-691-6941. The sample design of the survey conforms to professional statistical standards and to OMB Circular No. A46.