The Management and Organizational Practices Survey (MOPS): Collection and Processing

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Abstract

The U.S. Census Bureau partnered with a team of external researchers to conduct the first-ever large-scale survey of management practices in the United States, the Management and Organizational Practices Survey (MOPS), for reference year 2010. With the help of the research team, the Census Bureau expanded and improved the survey for a second wave for reference year 2015. The MOPS is a supplement to the Annual Survey of Manufacturing (ASM), and so the collection and processing strategy for the MOPS built on the methodology for the ASM, while differing on key dimensions to address the unique nature of management relative to other business data. This paper provides detail on the mail strategy pursued for the MOPS, the collection methods for paper and electronic responses, the processing and estimation procedures, and the official Census Bureau data releases. This detail is useful for all those who have interest in using the MOPS for research purposes, those wishing to understand the MOPS data more deeply, and those with an interest in survey methodology.

Keyword*:*

JEL Classification:

* Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. The Census Bureau developed the MOPS in partnership with an external research team that includes Nick Bloom (Stanford), Erik Brynjolfsson (MIT), and John Van Reenen (MIT). A grant from the National Science Foundation (NSF) and administrative support from the National Bureau of Economic Research (NBER) supported the work of this team for the MOPS 2010. Grants from NSF, NBER, the Kauffman Foundation, and the Sloan Foundation supported the work for MOPS 2015. We thank Lucia Foster, Ron Jarmin, and Julius Smith for helpful comments and review of this paper. We thank Abby Legge, Amy Newman-Smith, Luke Streng, and Colt Viehdorfer for their hard work in processing the MOPS data and preparing the tables for publication, as well as feedback on this paper.

1. Introduction

The Management and Organizational Practices Survey (MOPS) was developed by the U.S. Census Bureau in partnership with external researchers including Nick Bloom (Stanford), Erik Brynjolfsson (MIT), and John Van Reenen (MIT), and was collected as a pilot in 2010 as a supplement to the 2010 Annual Survey of Manufacturers (ASM). The 2010 MOPS surveyed approximately 50,000 establishments in the manufacturing sector on their management and organizational practices, their use of data in decision-making, and establishment characteristics. As a supplement to the 2015 ASM, the 2015 MOPS was again sent to approximately 50,000 manufacturing establishments on the topics included in the 2010 MOPS with expanded coverage on the use of data in decision making and establishment characteristics. The 2015 MOPS also included a new section on uncertainty. For additional expertise on this new content, Steve Davis (University of Chicago) and Kristina McElheran (University of Toronto) joined the existing research team. For an overview of the content of the MOPS, see Buffington, Foster, Jarmin, and Ohlmacher (2017).

The external researchers also collaborated with researchers from the Census Bureau's Center for Economic Studies (Lucia Foster and Scott Ohlmacher) and Associate Directorate for Economic Programs (Ron Jarmin and Cathy Buffington) to form a research team that validates the findings of the MOPS. See Bloom, Brynjolfsson, Foster, Jarmin, Saporta-Eksten, and Van Reenen (2013) for the first results of the work of this joint research team.

This paper documents the collection and processing of the MOPS. Except where otherwise noted, this paper refers to the MOPS 2015. Because the MOPS is a supplement to the ASM, we especially pay attention to differences between the ASM and MOPS collection and processing methodologies. Section 2 covers the collection of the MOPS data; Section 3 discusses the estimation methodology used to create the MOPS output tables and microdata; Section 4 describes the development of a research microdata files for users with approved projects; Section 5 concludes.

2. Collection

2.1. Collection Strategy

In 2010, the Census Bureau gave respondents to both the ASM and the MOPS the choice of using either a paper survey instrument or an electronic (internet) instrument. Beginning in 2014, the Census Bureau began to test the phasing out paper instrument collection for the ASM; beginning in 2016, the ASM moved to entirely electronic collection. In 2015, the ASM allowed for paper reporting but did not include a form in the initial mailing. For MOPS 2015, the joint research team again decided to give respondents the ability to choose paper or electronic reporting, and a paper form was included in the initial mailing. The research team chose to break from ASM mailing strategy based on the desire to maximize comparability between the 2010 and the 2015 MOPS waves. The MOPS research team also believed that,

in a time of increased digitization and computer use, the choice of reporting using a paper instrument might provide additional information about the management practices and the use of data at the establishment.

Research based on the 2010 MOPS provides evidence of the importance of measuring management practices. In the first study of variation in establishment-level management practices within a firm, a research team, including economists from the Census Bureau and partners from Stanford and MIT, finds that half of the large variation that exists in management practices across manufacturing establishments is explained by differences in the adoption of these practices within firms (Bloom, Brynjolfsson, Foster, Jarmin, Patnaik, Saporta-Eksten, and Van Reenen; forthcoming). The research team also finds that management practices are important and significant in explaining differences in establishment outcomes including productivity, profitability, survival, and growth (Bloom et al. 2013).

The desire to measure differences in management practices between establishments within firms as well as across firms led to the development of a unique mailing strategy for the MOPS that differs from the traditional ASM strategy. Under the ASM strategy, the Census Bureau mails surveys for all sampled establishments of multi-unit firms to the same address (called the "business address"), usually a headquarters address.[1] For the MOPS in 2010 and 2015, the instrument was instead mailed to each establishment in the sample at the physical address where that establishment is located, even when the establishment belonged to a multi-unit firm. It was in fact found there are differences in management practices between establishments within firms: Bloom et al. (2017) find evidence that 40% of the large dispersion of management practices that is present across plants occurs across plants within the same firm.

Based on anecdotal evidence from the cognitive testing process for the MOPS, ASM respondents frequently hold financial positions within the firm (for example, Controller or Accountant), rather than being plant managers of the type that may have the direct knowledge of the establishment that is most relevant to completing the MOPS.[2] In order to ensure that the respondent with the relevant knowledge received the MOPS, the survey mailings for establishments of multi-unit firms were addressed to the "Plant Manager."[3]

When developing the type and schedule of mailings ("mail strategy") for the 2015 MOPS, the joint research team as well as staff from the Census Bureau's Economy-Wide

[1] Several other surveys mail to the physical addresses of establishments that are part of multi-unit firms, including the Quarterly Survey of Plant Capacity Utilization and the Manufacturing Energy Consumption Survey.
[2] For more information on cognitive testing for the MOPS, see Buffington, Herrell, and Ohlmacher (2016).
[3] For single-unit firms, the survey mailings were sent to the attention of the contact name in the Census Bureau's Business Register where available and left blank otherwise.

Statistics Division (EWD) based their decisions on the 2010 mail strategy. Change in the strategy in 2015 resulted from changes in Census Bureau standards as well as the attempt to not reproduce errors that occurred in 2010.[4] The 2015 MOPS mailings included an initial mailing, a due date reminder card, a re-mailing to establishments that were initially deemed undeliverable by the U.S. Postal Service, a first follow-up mailing, and a second follow-up mailing. See Table 1 for mail operations and dates for both survey years of the MOPS. The Census Bureau sends and receives all physical mail through the National Processing Center (NPC), located in Jeffersonville, IN.

Initial Mailing

During the initial mailing, the Census Bureau sent respondents a packet that included a cover letter that described the purpose of the survey, the statutes authorizing the collection and guaranteeing confidentiality, login information for internet response, and the due date (June 24, 2016). The packet also included a flyer that gave general instructions about reporting and where to seek help if needed. Last, the packet included the paper survey instrument, Census Bureau form MP-10002.

Due Date Reminder Card Mailing

In 2015, all survey respondents who had not requested an extension received the due date reminder card mailing. In 2010, neither a specific due date nor a due date reminder card were used; this has since become a standard for Census Bureau economic surveys. In 2010, the initial mailing asked respondents to report within the 30 days after receipt of the packet.

Undeliverable as Addressed Mailing

The U.S. Postal Service (USPS) returned some packets to the NPC because the USPS could not find the address. The Census Bureau considers such packets "Undeliverable as Addressed" (UAA). If the UAA establishment was a single-unit, the Census Bureau sent all future mailings to the same addresses, even if the packet was initially UAA. Based on Census Bureau experience in handling UAAs, the USPS is occasionally successful in delivering additional mailings to respondents whose initial mailing was marked UAA. On the other hand, occasionally the USPS was unable to deliver subsequent mailings to addresses from which they did not return the initial mailing as UAA. If the UAA establishment was a part of a multi-unit firm, the Census Bureau resent the package along with packages for any other UAA establishments belonging to the same business to the ASM business address during a special UAA mailing operation.

[4] For 2010, the methodology used to construct the MOPS mail file generated a smaller mail file than the ASM mail file, and the first follow-up mailing was accidentally sent to some respondents who had already submitted their responses.

As a policy, the Census Bureau considers any UAA establishment to be UAA until the NPC receives a *paper* response to the survey for the establishment. Thus, if a respondent receives a subsequent mailing and does not respond to the survey, submits an electronic response to the survey, or otherwise contacts the Census Bureau to resolve the case (for example, calling to inform the Census Bureau that their establishment is closed or out-of-scope), the Census Bureau continues to consider that establishment UAA. That is, an establishment can be flagged as UAA and still have response data. Because UAA status does not prove that an establishment has closed, UAA establishments are considered eligible for collection. Thus, other than the UAA mail operation, UAA status does not impact collection or processing.[5]

Follow-up Mailings

In 2015, the Census Bureau considered respondents eligible for the next mailing if they had not requested an extension, were not an active referral, or had not received a valid check-in code from either the paper or electronic collection systems. An active referral is a case in which a respondent contacted the Census Bureau or was contacted by the Census Bureau with a problem related to their reporting. The NPC gave each paper submission a check-in code and check-in timestamp (time and date) upon opening the package and scanning its barcode. Electronic instruments received a check-in code and timestamp when they were collected in nightly batch processing. See Section 3 for information on the batch processing of electronic submissions.

First follow-up mailings for respondents who did not respond by the due date included only a letter for both the 2010 and 2015 MOPS. For the MOPS 2015, the Census Bureau sent these follow-up letters after the due date, and the letter stated, "Past due – respond within 10 days." The second follow-up mailing included both a letter with the same past due language and a form.

As part of the collection strategy, the MOPS mail sample was created by supplementing the 2015 ASM mail file (created in January 2015) with cases determined to be eligible for the ASM based on updated information in the Business Register. The Census Bureau applied the same selection criteria for the selection of ASM cases to the Business Register just prior to the mail out of the MOPS. Because the 2015 MOPS mailed several months after the 2015 ASM, new establishments of multi-unit firms ("births") or newly in-scope manufacturing establishments that were identified in responses to the 2015 ASM and passed to the Business Register were included in the first follow-up mailing for the 2015 MOPS.

[5] Bloom et al. (2013) calculate the survey response rate for the MOPS 2010 as the number of check-ins divided by the number of mailed packages less UAA establishments. For the MOPS 2015, having at least one UAA check-in does not establish that the unit should not be considered as part of the overall sample since it is possible to have a UAA check-in and have a subsequent package successfully delivered, regardless of whether or not a response is returned.

Respondent Correspondence and Duplicate Mailing Issue

The Census Bureau's Business Help Site (BHS) provided an FAQ page and allowed respondents to print copies of the MOPS survey instrument, send questions to an analyst through a secure messaging center, or request extensions. Respondents could request extensions that could extend the reporting period until the end of the collection period. Respondents who requested extensions were excluded from follow-up mailings.

The Census Bureau provided a phone number for respondents to use to speak with a clerk at the NPC. Training materials prepared for the clerks included information on how to respond to questions on reporting if the establishment was not in business in one or both of the periods covered by the MOPS survey or if the respondent believed they had received the form in error. Clerks who could not resolve issues referred those issues to headquarters for further review (U.S. Census Bureau, 2016). The online FAQ and the instructions for the clerks included the same information; for additional detail see Appendix A.

After the initial 2015 MOPS mailing, some MOPS respondents contacted the Census Bureau indicating that they received two or more MOPS initial mail-out packages to a single establishment location. It was determined that just over 800 multi-unit establishments in the MOPS sample shared their name, street, and city with another establishment in the mail file, resulting in these duplicate packages. Further research indicated that when an establishment had a duplicate, the duplicate belonged to the same multi-unit organization (firm). It was determined that duplicates could originate from duplicate records within the Business Register (which is the source of the MOPS mail file) or represent cases for which not enough information was available within the mail file extracted from the Business Register to differentiate between separate physical establishments.

A few hundred of the duplicate establishments did have unique store numbers or NAICS codes listed in the Business Register, meaning two different establishments may exist but share name and mailing address information within the Business Register.[6] For the 2015 MOPS, the store number and NAICS code was loaded into the processing system, and the clerks working in the telephone call center reviewed store numbers and NAICS codes with any respondent that called about duplicate packages in an effort to resolve whether the duplicate packages were the result of duplicate records in the Business Register or were meant for delivery to unique establishments.

Some respondents who received duplicate packages submitted only one response. When telephone contact information was available, a Census Bureau employee called these establishments in order to resolve the issue surrounding the duplicate package. When the

[6] In some cases, a single establishment that produces significant values of products across more than one NAICS code may report different NAICS codes separately for the ASM. Internally, the Census Bureau refers to these cases as "splitters." These splitters may have accounted for some share of the duplicate packages.

Census Bureau employee and the respondent could identify multiple establishments, the employee asked respondents to deliver the duplicate package to the appropriate establishment. When the Census Bureau employee and the respondent identified true duplicate records, the employee flagged the records in the processing system and reviewed them with the Business Register staff.

2.2. iCADE

For the MOPS 2015, the Census Bureau used its integrated Computer Assisted Data Entry (iCADE) system to process paper forms. Paper data processing occurred at NPC. After a check-in operation, forms were batched and scanned, and a batch number and a sequence number within the batch were assigned to each form. Optical mark recognition (OMR) was applied to all check-box item data and optical character recognition (OCR) was applied to numeric data. Clerks then viewed the images from the scanning operation and keyed the remaining text box items. The Census Bureau refers to these items as "keyed from image" (KFI).

The Census Bureau trained clerks on the specifics of the MOPS instrument. Certain rules, such as character set restrictions or range edits, constrained the clerks when they keyed fields. For example, items that ask for a percentage value had a range edit restricting the response to the range [0,100]. Any reported values out of this range were top-coded to 100 during the keying process, and the item received a flag. If there were any stray marks on a page containing only check boxes, iCADE generated a page flag so that a manual review could take place. For pages with write-in data items, iCADE assigned stray mark flags to the nearest write-in item. See Table 2 for the set of edits applied to MOPS data during the KFI operation. See Table 3 for the set of flags used during keying (including the page flag) and their description.

The Census Bureau stores images of scanned paper instruments as PDFs for reference in the Feith Document Database (FDD) system. Within FDD, a user can use the Census Bureau survey respondent identifier to locate the scanned form. Data were output after the keying operation to ASCII data using the Census Bureau's Standard Data Output (SDO) format. These SDO records were sent nightly to the Census Bureau's economic survey processing system for ingestion and processing, as described in Section 3 below.

2.3. Centurion

The Census Bureau has used a secure online reporting application called Centurion for select economic surveys and censuses since 2008 (Ahmed and Piesto, 2012). The Census Bureau utilized this system for both the 2010 and 2015 MOPS. Respondents received a unique user ID and corresponding password for logging into Centurion printed on both the paper copy of the survey instrument and the instruction letter that accompanied the form as part of the initial mail package. The user ID and password were also reprinted on each reminder or follow-up mailing sent to the respondent.

Respondents who chose to enter data electronically were first presented with name and address information from the Business Register (BR) that was used to populate the initial mailing. The respondent had the ability to edit this information if desired before responding to the MOPS questionnaire. Centurion then presented the MOPS content in sequential order. For most questions, Centurion presented one numbered question per screen.

For Section D – Uncertainty, the MOPS team chose to present two questions per screen. Section D consisted of eight questions in four pairs. In each pair, the first question asked for the values of a variable of interest for reporting periods 2015 and 2016. Because respondents completed the survey before the end of 2016, the latter value is a partial forecast. The second question in each pair asked for a five-point forecast for the same interest variable in 2017. To aid respondent understanding of these questions, the MOPS team chose to present the pairs of questions referring to each interest variable (shipments, capital investment, employment, and materials cost) on the same screen in Centurion. See Figure 1 for an example of a pair of questions from Section D – Uncertainty from the Centurion instrument.

For most questions on the instrument, excluding items 30-38, 45, and 46, the MOPS asked respondents to complete the item both for the current reference period and for a recall period five years prior. Centurion presented the recall period above the current reference year on the screen for the Centurion instrument. This reflects the fact that the recall period was in a column to the left of the current reference year for most items with a recall component on the paper instrument. See Figure 2 for an example of the standard paper (2a) and Centurion (2b) question presentation. The exceptions to this rule were items 27 and 28, which each include two tables. On the paper form, the table for 2015 responses preceded the table for 2010 responses for each item. Based on evidence from the usability testing of the instrument, the MOPS team chose to reverse this ordering of tables within items 27 and 28 relative to the paper form. This decision ensured consistency in the ordering of the recall and current period questions within the electronic instrument. See Figure 3 for a comparison of the paper and electronic presentations of items 27 and 28.

After entering data on each screen, the respondent had the option to click on a button that read "Save and Continue." Clicking on this button saved the respondent's data for that item and advanced the instrument to the next screen. If the respondent exited the instrument without selecting "Save and Continue" on a particular screen, Centurion would not save any data entered on that screen. Centurion would have saved any data from preceding screens where the respondent did press "Save and Continue."

If there were any issues with the entered data at the time that the respondent pressed the "Save and Continue" button, she received a message in red text at the top of the page detailing the issue. If she had not answered a question on the page, the "Save and Continue" action produced a warning in red text prompting the respondent to answer the relevant question. The Census Bureau calls these messages "edits." Examples of issues that generated

edits include failure to respond to all or part of an item or likelihoods that did not sum to 100% in items 31, 33, 35, and 37. For the MOPS, "soft edits" were employed. That is, if the respondent clicked on "Save and Continue" again after the edit was generated, she advanced to the next screen, regardless of whether or not the issue had been corrected.[7] Sample edit language for item 1 is visible in Figure 4.

In addition to the "Save and Continue" button, there was also a "Previous" button that allowed the respondent to return to the previous screen. Until the respondent had seen all of the screens associated with the items on the survey, she could only navigate the Centurion instrument using these two buttons. Centurion automatically cleared all previous edits after the respondent navigated to another screen. Therefore, if the respondent returned to a screen with outstanding issues and attempted to click "Save and Continue," Centurion generated the soft edit again.

Once the respondent had viewed all of the content of the MOPS questionnaire, Centurion presented her with a review screen. This review screen listed all questions on the survey as hyperlinks that navigated directly to the specific question. Any question with unresolved issues had the number of issues listed beside the link to the question. If the respondent navigated to a specific question, she had the option of returning to the review screen, changing or adding to a previous input, and the ability to "Save and Continue."

The review screen also offered the respondent the opportunity to submit her data. Upon submission, Centurion generated an SDO that the Census Bureau processed through the Standard Economic Processing System (StEPS) II. We discuss processing at length in Section 3.1 below. Centurion offered the respondent the option of printing a PDF of her responses for her records after she submitted her data.

If the respondent did not press the "Submit" button, Centurion did not generate an SDO, and the processing system did not automatically read in the data. After the collection period ended, the Census Bureau collected approximately 1,100 records of respondents who completed the key items for tabulation (see Section 3.3) but who did not submit their data by pressing the "Submit" button or via mail or fax. This "data dump" was collected in the SDO format and added to the processing system by Census Bureau staff prior to the start of processing the survey collection.

Several elements of the Centurion system may have generated meaningful differences in the quality of responses received versus the paper forms. As noted above, Centurion generated soft edits when there were issues with data entered by the respondent for an item.

[7] Note that if a change was made in response to an edit that either failed to correct the issue or generated a different issue, no edit was generated when the respondent pressed "Save and Continue" a second time. All outstanding issues, including those that did not generate additional edits, were displayed on the review screen that appeared at the end of the survey instrument.

All questions generated a soft edit when the respondent failed to respond to an item on the screen. The presence of these edits may have generated higher item response rates through various channels. For example, these edits may have drawn respondents' attentions to unintentionally skipped items. Additionally, respondents may have felt compelled to revisit intentionally skipped items and provide responses because they received edit messages.

Particularly on Section D of the survey, the edits provided guidance beyond simple completion. For example, each of Questions 31, 33, 35, and 37 asked respondents to provide likelihoods that each of five possible forecast outcomes would occur. These likelihoods should have summed to 100% for each item. On the paper instrument, there was a pre-filled box at the bottom of the column where the respondent wrote her likelihoods that indicated that the sum of the column should be 100%. In Centurion, this box was dynamic, making it easier for the respondent to see how she has allocated the likelihoods as she responded to each item. If the sum was not 100%, Centurion generated a soft edit. Centurion generated similar soft edits if the respondent did not provide five projections and corresponding likelihoods or if the five projections were not in ascending order.

Centurion also prevented certain logical errors in multiple-choice questions. For example, on items where the instructions read "select one response for each year," Centurion did not allow for multiple selections within the items. In 2010, Centurion prevented respondents from selecting certain combinations of responses in items where the instructions read "select all that apply." For example, item three asked "How frequently were the key performance indicators reviewed by managers at this establishment?" In 2010, respondents could not select "Never" and another frequency such as "Yearly" or "Daily" for this item. For MOPS 2015, it was determined that a respondent could conceivably have some key performance indicators that were collected but never reviewed while other indicators were reviewed daily, and so for questions of this type multiple selections of any combination of variables were allowed in 2015.

Finally, Centurion automatically enforced the skip patterns in the questionnaire. For instance, if a respondent answered "No key performance indicators" for both years in item two, the paper form instructed her to skip to item six. If completing the survey electronically, Centurion automatically skipped the screens for items three through five when the respondent answered "No key performance indicators" for both years in item two.

There was an issue with Centurion that made it possible for respondents to submit data for items that they should have skipped. Consider a respondent who did not select "No key performance indicators" for both years in item two. She completed items three through five, and then proceeded to complete the rest of the survey. She reached the review screen and decided that it would have been more accurate to select "No key performance indicators" for both years in item two. She returned to item two and changed her responses. If she pressed "Save and Continue" at this point, she would have jumped to item six. If she pressed "Return

to Form Review," she would have returned to the review screen. No matter which selection was made, Centurion retained the data that she previously entered in items three through five and included the data in the SDO. The respondent could no longer see that data. In fact, the only way for her to have seen the data was to change her responses to item two again. Preliminary research from the MOPS 2010 suggests that this did not occur in 2010 although it was possible.

3. Processing and Estimation

Both iCADE and Centurion produce SDOs, which the Census Bureau processed using the Standard Economic Processing System II (StEPS II). We detail this processing system in section 3.1. The Census Bureau used the data processed through StEPS II to produce official publication tables as well as a research data file. We also describe the method of generating the derived items from the raw data for use in official output below.

The Census Bureau did not use StEPS II or its predecessor, Legacy StEPS, to process the MOPS 2010. Instead, the Census Bureau securely made the raw SDOs available to the MOPS sponsors, who processed the data in the Federal Statistical Research Data Center (FSRDC) system using STATA. Because the MOPS 2010 was a pilot survey, the Census Bureau did not publish official tables. Instead, the Census Bureau produced a press release and corresponding working paper detailing initial findings from the survey (Bloom et al., 2013). The research data file developed by the MOPS research team is available for approved research projects as part of the FSRDC system.[8] After validation exercises were performed on the 2015 MOPS data, the Census Bureau provided a similar research file for approved projects through the FSRDC system, described in section 4.

3.1. StEPS II

The Census Bureau introduced StEPS II in 2014 as a replacement for the original StEPS system, now called "Legacy StEPS" (Russell, 2012). StEPS is a generalized processing system that consists of standard data set structures and integrated modules that allow users to perform the necessary tasks associated with each step of the survey life cycle (Ahmed and Tasky, 2000).

For the MOPS 2015, both iCADE and Centurion produced SDOs in order to batch process respondent submissions. For the MOPS 2015, these SDOs were collected nightly at 8:30 pm Eastern Daylight Time by the StEPS II system. When the respondent pressed the "Submit" button in Centurion, Centurion set a flag to "TRUE." Each evening, StEPS II processed any data in records that had flag set to "TRUE" at 8:30 pm on that date. After StEPS II processed the data, Centurion reset the flags to "FALSE" nightly. This timing convention may have caused StEPS II to process some data that the respondent entered *after*

[8] For more information on the FSRDC system, see https://www.census.gov/fsrdc

she pressed "Submit." For example, if a respondent entered data into Centurion and pressed submit at 10 am, then changed some responses at 4 pm, StEPS II would process the data as of 4 pm, regardless of whether or not the respondent pressed submit again at 4 pm. On the other hand, if the respondent first submitted data at 10 am, then made her changes at 9 pm and did not press submit, StEPS II would only process the data as the respondent submitted it at 10 am. StEPS II would not process the changes made at 9 pm until the respondent pressed submit again.[9]

StEPS II allowed multiple data versions to be stored within the system. The first time that data was read into StEPS II it was saved as "Originally Reported" (OR). StEPS II never overwrote or changed OR data. The OR data then populated the downstream data versions, which included "Latest Reported" (RP), "Machine Edited" (ME), "Final" (FN), and "Weighted" (WG). Figure 5 shows all data versions and the order in which StEPS II populated them in the data stream.

Any time during the collection period that new data was available in the nightly processing, the new data replaced the existing data in the RP fields. StEPS II could have overwritten the RP field as many times as there are days in the collection period since StEPS II processed the SDOs nightly. This field always reflected the latest data submission. There was an exception for empty data items, which could never overwrite submitted data.[10]

StEPS II saved data in a "skinny" format in which each survey item and value is stored as an individual record identified by survey ID (Ahmed and Tasky, 2000). This implies that, because StEPS II could overwrite the RP field multiple times, there is no way to differentiate among successive submissions for a given establishment. Also, reported items may be of different vintages because the OR data was populated at the data item level, not the response level.[11]

Furthermore, there is no way to determine how many submissions each respondent made. StEPS II saved a "check-in date" variable, but overwrote this check-in date any time that new data was found in the SDO. For paper records, StEPS II saved the check-in date when NPC

[9] If the respondent never pressed "Submit" again, StEPS II would never process the un-submitted data in this case. The Census Bureau captured all such data after the collection period ended, but did not process any data for respondents who had previously submitted data.

[10] Once the respondent selected a response to an item in Centurion, she could not revert that item to no selection, so it was not possible to generate an empty value from a completed value for repeat Centurion submission. Thus, the exception for empty items could only be invoked if the respondent returned multiple paper forms or both paper and electronic forms.

[11] For MOPS 2015, an automatic process generated and overwrote these "fat files" every thirty minutes between 7:00 am and 7:30 pm EDT on weekdays. The only way to examine differences in respondent submissions would have been to save all fat files and compare among them. Because this would be very costly in terms of storage space, only intermittent fat files were saved to be used by the research team for preliminary inquiries.

first received the form and then overwrote it with a new date when the data was read into iCADE, which generally occurred several days later.

For the Census Bureau to consider a record for tabulation in 2015, respondents must have provided responses to seven key items for reference year 2015: items 1, 2, 6, and 13-16. The Census Bureau chose these items as key items because they form the smallest subset of items from Section A on the survey instrument that respondents must have completed if they properly followed the skip patterns associated with Section A. Since Census will only publish official tables for data from Section A for MOPS 2015, responses for these seven key items are necessary to compute an index of structured management practices (see Section 3.3 below). For ease of exposition, we refer to responses having data for the seven key items as "complete cases."[12]

The "Unit Response Rate" (URR) is the rate at which the Census Bureau processes complete cases.[13] The final URR for the MOPS 2015 was 70.9%, covering 71.9% of ASM shipments.

The Census Bureau collected data for the MOPS 2015 through October 31, 2016. Processing of paper forms at NPC ended on September 30, 2016, but Andrew Hennessy from the Economy-Wide Statistics Division (EWD) manually processed responses from the approximately 130 paper forms received after that date. Prior to the closing of Centurion collection on October 31, Hennessy keyed the first 16 questions from late paper responses into Centurion and manually set the data source within StEPS II to reflect that these were paper submission. For questions 17-46 and for late paper responses received between October 31, 2016 and March 1, 2017, Hennessy keyed the data directly into StEPS II.[14] Hennessy did not key data from late paper records that already had data in StEPS II at receipt of the late record due to either electronic submission or earlier submission of a paper form, and there are no plans to key that information. The Center for Economic Studies scanned and archived all late paper submissions.

In addition to the seven key items, an establishment must be a tabulation case in the 2015 ASM to be included in the MOPS tabulation sample. Thus, the release of the MOPS 2015 tables followed the release of the 2015 ASM tables. The MOPS 2015 tables were released on April 11, 2017. Census Bureau staff loaded the 2015 ASM tabulation status flag, along with

[12] In StEPS II, a "check-in" is any observation with submitted data, and a "response" is any observation with reported data in the seven key items.
[13] There is another measure of response completeness called the Total Quality Response Rate (TQRR). TQRR is an item-level measure that gives the share of the total data that respondents reported for that item (versus data that Census imputes). We have not calculated TQRR for the MOPS.
[14] Initially, only responses to the first 16 questions were keyed to facilitate production of the MOPS publication tables.

NAICS industry and employment reported from the 2015 ASM and establishment age from the Longitudinal Business Database, into StEPS II.

3.2. Feith Document Database

Although not specifically for processing, Census Bureau employees can conduct additional review of paper and electronic forms using a system called Feith Document Database (FDD). FDD is a document storage system that can be used to access images of the scanned paper MOPS submissions. This system allows analysts to inspect paper forms where iCADE flags were set or to review sections of the form that may not have been keyed (e.g. the "Remarks" section of the form). Survey forms with populated responses from Centurion submissions are also archived and available for user review in FDD.

FDD was used to verify the data in StEPS II for a small number of paper forms. There are no plans to do further review of the paper forms using FDD.

3.3. Estimation

In order produce official tables for publication on the MOPS 2015, we first translated the qualitative data on management practices gathered by the survey into meaningful quantitative derived items for use in estimation. The process of preparing the submitted data to produce sample estimates was as follows: first, we developed a series of rules to correct the user-reported data for common issues and produce machine-edited data. Next, the MOPS team transformed the machine-edited data into derived items for tabulation. Subsequently, the MOPS team, including Census Bureau mathematical statisticians, identified cases for tabulation and produced estimates using the derived items.

Edits and Machine-Edited Data

The common issues that arise within submitted data are primarily the result of errors on the part of the respondent or skip patterns inherent in the survey instrument. In order to address these issues, StEPS II first flagged the data. Census Bureau parlance refers to these item flags as "edits," but these edits do not necessarily result in changes to any data version. For the MOPS 2015, current period (2015) and recalled data (2010) received edits independently within a question. That is, the MOPS team considered the current and recall data to be separate items.

The Census Bureau developed item edits for four common scenarios related to the questions covering management practices. First, the Census Bureau applied edits in cases where the respondent selected more than one response and the question specified that she should "mark one" response. Second, the Census Bureau applied edits in cases where the respondent selected more than one response and the question specified that she should "mark all [responses] that apply." Third, the Census Bureau applied edits in cases where the respondent did not skip questions that she should have skipped based on prior responses. Finally, the Census Bureau applied edits in cases where the respondent properly followed

skip patterns in order to identify skipped questions for later simple imputation. Table 4 provides a summary of the order of these edits and the machine edited data actions that result from these four cases, referred to as Edit 1, Edit 2, Edit 3, and Edit 4, respectively.

Edit 1 refers to the case where a question specified "mark one" response but the respondent selects more than one response. This edit only applied to cases where the respondent returns a paper copy of the survey. As noted in Section 2.3 above, Centurion did not permit multiple selections on questions where the instructions specified that the respondent should "mark one" response. For paper responses to the 2010 MOPS, the MOPS research team nullified the entire item if the respondent incorrectly selected multiple responses. Because items 1, 2, 6, and 13-16 were key items, nullifying submitted data would have increased the risk that a record would be ineligible for tabulation and would thus lower survey response rates. As such, for the MOPS 2015, the Census Bureau populated the ME version of the data with the most structured management practice selected by the respondent if the Edit 1 flag was set.[15]

Edit 2 refers to the case where a question specified that the respondent should "mark all [responses] that apply," and she selected more than one response. The Census Bureau needed to assign a single structured management score for each item per respondent to serve as an input into the single index value for management. When constructing this score for "mark all that apply" items in 2010, Bloom et al. (2013) took the average of the scores associated with all selected responses. Taking the average lowers the index value for respondents who choose more than one response relative to choosing the highest applicable score. It is not clear that taking the average accurately reflected the structure of management practices. For example, question 3 asked how frequently managers reviewed key performance indicators (KPIs) at the establishment. It may not necessarily be true that a respondent who selected "yearly," "monthly," and "daily" had less structure in her management practices than a respondent who selected only "daily." In fact, she may have had more structured practices if, for example, she had a variety of KPIs that managers may have reviewed at different intervals for specific reasons. As a result, for the MOPS 2015, the Census Bureau imputed the ME version of "mark all that apply" items to the most structured practice selected by the respondent if the Edit 2 flag was set.

Edit 3 refers to the case where a respondent answered at least one question that should have been skipped based her response to a prior item. This could occur in either electronic or paper formats. Both the electronic and paper forms stated that skips should occur only if the respondent selected the skip-generating responses for both the current and prior periods. This did not prevent respondents from providing inconsistent responses to subsequent items based

[15] Census associated the "most structured" response to each question with the response with the highest monotonic score in Table 7 of the responses selected by the respondent. Census constructed the derived items for each question from the monotonic scores in Table 7.

on their prior responses. As described in Section 2.3, under very rare circumstances a respondent could generate data for questions that she should have skipped based on her final submitted responses. Of course, on the paper form, nothing prevented the respondent from answering questions even if the instructions to prior items instructed her to skip them. We refer to the item that indicated that the respondent should skip future items based on her response as the "trigger question" for the skip pattern.

In the case of Edit 3, the trigger question received an edit if the respondent provided responses to subsequent items that she should have skipped. Although responses to these items may have been inconsistent with the response to the trigger question, there was no way to determine which responses matched the intentions of the respondent. As such, we treated even inconsistent data as valid under Edit 3, opting only to flag issues rather than produce changes in the ME data.

Edit 4 refers to the case where the respondent properly followed skip patterns. An edit flag was set on the trigger question when the responses to subsequent questions are empty as prescribed by the skip pattern. That is, if a respondent selected "No Key Performance Indicators" for item 2, she was instructed to skip to item 6. If for this respondent item 2 has the value corresponding to "No Key Performance Indicators" and items 3, 4, and 5 do not contain data, then the edit flag is set on item 2. In general, the ME data for the subsequent questions was set to the least structured practice in the set of all possible responses when the Edit 4 flag was set. That is, in the previous example, items 3 and 4 would be set to the value corresponding to the response "Never" and item 5 would be set to the value corresponding to the response "We did not have any display boards" after simple imputation. In 2010, null data due to skip patterns were not altered, which had two effects. First, this reduced the number of respondents in the research sample, as respondents who properly followed skip patterns may have answered fewer the minimum of 11 items necessary for inclusion in the sample. Second, it biased the index upwards since the management index was a simple average of completed items for each respondent. Setting the machine-edited data to the least structure practices eliminated this upward bias.[16]

For items 7, 8, 10, and 12, the Census Bureau determined that it would be inaccurate to impute the least structured response under certain applications of the skip patterns. For example, assume that the respondent selected "No production targets" in item 6, which asked about the time frame of production targets at the establishment. It would be inaccurate to say that the establishments' targets were "possible to achieve without much effort" or known "only [to] senior managers," the least structured responses to items 7 and 8 respectively. Similarly, assume that the respondent selected "no performance bonuses" as her response to

[16] Since current period (2015) and recalled data (2010) received edits independently, Edit 4 was applied if the respondent chose the skip-generating response in the trigger question for the current period (recalled data) and skipped subsequent items for the current period (recalled data) regardless of her responses for the recalled data (current period).

item 9 (11). It would be inaccurate to impute "Production targets not met" in response to item 10 (11), even though that is the least structured response. In these cases, the Census Bureau assigns a value of "99" to the ME data for the items in question, which identifies them for further processing.

Derived Items

After performing the simple imputations to generate the ME data as described above, the Census Bureau generated derived items from the ME data. These derived items are stored in the Final (FN) version of the data in StEPS. The derived items included item-level structured management scores and the establishment-level structured management score. In 2010, the research team assigned each item a score on a scale between zero and one, with zero corresponding to the least structured response and one corresponding to the most structured response. The Census Bureau utilized the same scoring metric for the MOPS 2015. Table 5 shows the scores associated with each item and response.

The establishment structured management score is the simple average of the establishments' scores for the first sixteen items. The Census Bureau computed this mean with a dynamic denominator, so that the denominator was the number of non-empty item-level scores for each respondent. Thus, the denominator ranged between seven (the minimum number of responses if the respondent completed only the key items) and 16 (the number of questions on management practices).

The Census Bureau assigned a value of zero to the derived items associated with ME data that was populated with a "99." Although it would be inaccurate to state that the respondent selected the particular responses that were deemed "least structured" out of the list of possible responses, these respondents had relatively unstructured practices based on their responses to the trigger question.

Estimation

As described in Section 3.1 above, the Census Bureau released tables based on Section A of the MOPS, which covers management practices, on April 11, 2017. These tables and a corresponding tip sheet are available at https://www.census.gov/programs-surveys/mops.html. Results from other sections of the 2015 MOPS will be released via research papers through the CES Working Paper Series. This research will inform the potential publication of official tables on these sections for future MOPS waves.

The publication tables for the 2015 MOPS primarily consisted of average overall management scores by industry subsector, state, establishment employment size, and establishment age classes. The Census Bureau also released a table showing what fraction of respondents provided each response to each question based on the ME data. For items that specified that respondents should "mark all that apply," these tables were produced using a

combination of the ME and RP data. If the ME data were imputed according to Edit 2, then the Census Bureau populated the tables using the ME data. Otherwise, the Census Bureau used the RP data to populate the tables in order to preserve selection of multiple responses. If the ME data was '99' in accordance with imputation from Edit 4, the Census Bureau grouped the responses in the share of respondents who did not respond to the item, as it would have been inaccurate to group them with the "least structured" responses.

Sample weights for the MOPS were based on the sample weights from the 2015 Annual Survey of Manufactures mailout sample. Census Bureau Mathematical Statisticians constructed post-stratified weights prior to publication tabulations. The post-stratified weights were calculated by multiplying the MOPS sample weights by a unit nonresponse adjustment factor as well as a calibration factor. The unit nonresponse adjustment factor was calculated based on 2015 MOPS. The calibration factors used the final 2015 ASM weights as the population totals. Sample weights for the MOPS 2010 are available on the associated research file and were adjusted for a sample that requires data for 11 of 16 items in Section A and ASM TABSTAT = "Y," among other factors. The released statistics from the 2010 MOPS press release and Bloom et al. (2013) are unweighted.

The MOPS 2015 publication tables contain estimates constructed using post-stratified weights. For the tables that present the average management score by state, industry (3-digit NAICS), employment size, and age, the average management score is the weighted average of the establishment-level (unweighted) management score for each by-group. The table presenting the share of responses to each question displays weighted response shares. Sample and post-stratified weights are available on the associated research file for MOPS 2015.

As with the ASM, and indeed all Census Bureau data releases, the publication tables for the MOPS were reviewed to ensure that "no data are published that would disclose the operations of an individual establishment or company," in accordance with Federal law (Titles 13 and 26 of the United States Code).[17]

For additional information on the Methodology for the 2015 MOPS, visit https://www.census.gov/programs-surveys/mops/technical-documentation/methodology.html.

[17] Source: The Annual Survey of Manufacturers Methodology. For more information on disclosure avoidance at the Census Bureau, see https://www.census.gov/programs-surveys/economic-census/technical-documentation/methodology/disclosure.html

4. Research Microdata File Preparation

4.1. MOPS 2010

Because the MOPS 2010 was conducted as a pilot, the 2010 MOPS microdata file was prepared by the research team. Many of the details of the microdata construction may be found in Bloom et al (2013). The 2010 MOPS microdata file includes each of the survey responses: one for reference year 2010 and one for recall year 2005. The file also includes duplicate records resulting from the cumulative nature of the files downloaded from one of the Census Bureau's collection systems. The research team constructed flags to identify duplicate records and the research team's baseline sample. The baseline sample was created from the set of approximately 37,000 unique respondent records using the following criteria:

- at least 11 non-missing responses to the first 16 questions;
- a successful match to the 2010 Annual Survey of Manufacturers (ASM) using the unique establishment identifier;
- a positive tabulation status for the 2010 ASM;
- a valid identifier in the Longitudinal Business Database (LBD) when matched using the 2010 ASM assigned LBDNUM identifier;
- positive value added as reported in the 2010 ASM;
- positive employment as reported in the 2010 ASM;
- positive imputed capital.

Most of the MOPS questions allow for responses for 2010 (the reference period) and 2005 (the prior period). For those items, the unique respondent identifier and the year variable can be used to differentiate between reported values for reference and prior periods. When the question was only asked for the reference period, the value for reference period is included in both records.

When questions allow for "Check all that apply", the MOPS microdata file includes variables that represent each possible answer as well as a separate score measure. For example, question nine allows for five possible answers. The MOPS microdata file includes variables {q09_1, q09_2, q09_3, q09_4, q09_5}; each may take the value of {0,1}. In addition, there is an aggregate score variable, bs_q09. Scores are calculated for both the reference and prior reporting periods.

Along with scores for questions that allow for "Check all that apply", Bloom and Saporta-Eksten calculated standardized management scores ("bs_") for both the reference year and the recalled or prior period (bs_management), as well as measures of data driven performance monitoring (bs_monitoring) and the use of incentives and targets (bs_incentives). Each score is calculated at the establishment level using the same methodology at the establishment level for each year using the following methodology:

The management score for each establishment is generated in two steps. First, the responses to of the 16 management each questions are normalized on a 0-1 scale. The

> response which is associated with the most structured management practice is normalized to 1, and the one associated with the least structured is normalized to zero. We define more structured management practices as those that are more specific, formal, frequent or explicit. For example, when asking "...when was an under-performing non-manager reassigned or dismissed?", the response "Within 6 months of identifying non-manager under-performance" is ranked 1 and the response "Rarely or never" is ranked 0. If a question has three categories, the "in between" category is assigned the value 0.5. Similarly for four categories the "in between" categories are assigned 1/3 and 2/3 and so on. Second, the management score is calculated as the unweighted average of the normalized responses for the 16 management questions. In robustness tests we also evaluated another way to average across the 16 individual scores. We used a management z-score, which normalizes each question to have a mean of 0 and a standard deviation of 1 and averaging across these. We found that all our results were extremely similar because the average z-score is extremely correlated with our main management measure. (Bloom et al., 2013)

The monitoring score averages individual question scores across items {1-5, 8} while the incentives and targets score averages across items {6, 7, 9-16}.

The management section of the MOPS instrument includes built-in skip patterns. For example, if a respondent answered "No production targets" in question 6 for both 2005 and 2010, the respondent is directed to skip to question 13. Skip patterns generate missing data and, unlike the processing for the MOPS 2015 described in Section 3.3 above, those missing values are dropped from the management score calculations. Likewise, those who chose to answer questions that were supposed to be skipped based on these "trigger" questions that generate skip patterns had those responses included in their management score calculations.

4.2. MOPS 2015

The MOPS 2015 microdata file was constructed at the Center for Economic Studies using the processed data from StEPS II. The microdata file contains the response data for all 46 questions from the MOPS 2015, excluding the data from Section D – Uncertainty. The data for Section D will be made available in 2019, once the forecast variables can be validated relative to realized 2017 outcomes. Data is provided for all establishments for which the check-in date is non-missing. The data is reshaped so that the 2010 recall data are separate observations from the 2015 reported data. Observations from the same establishment will share an ID, but will have different values populated under the "year" variable. A recall flag is also set equal to one for the 2010 recall data and equal to zero otherwise. For checkbox questions where there is no recall component, the corresponding variables will be empty in the recall observations. The respondent start date and the completion date (discussed below) are both populated with the same value for both the reported and recall observations for any given ID.

For items 1-16, several versions of the data are provided. The last reported data, which have not undergone editing and imputation, are provided under each variable name. The edited and imputed data version used as an intermediate input into the construction of the published tables is also provided with the prefix "pub." This version of the data is equivalent to the machine-edited (ME) data version described in Section 3.3 above. Derived items for items 1-16 are also made available as "QXX_pub." The derived structured management score is in the variable "management_pub." It is important to note that because the MOPS 2010 microdata was prepared under different rules for editing and imputation, the management scores are not directly comparable. Data users will need to construct comparable management scores over survey waves.

We also make the scores from Bloom et al. (forthcoming) available on the microdata file. The item-level scores are made available as "QXX_aer," and the structured management score is in the variable "management_aer." The Bloom et al. scores have four differences from the tabulation scores. First, in the case of "mark all that apply" items, the score is the mean of the scores associated with all selected responses, rather than the max of the associated scores. Second, for "mark one" items for which the respondent selected more than one item, the response is treated as missing rather than taking the max of the scores associated with all selected responses. Third, for items 7-12, scores of zero are not imputed when the skip patterns are properly followed, but rather the skipped items are treated as missing. Finally, instead of requiring the seven key items to compute the management score, Bloom et al. compute the management score when any 10 or more items are populated.

For all checkbox items, the provided data is numeric, with each digit corresponding to the order of the selected boxes. Consider a hypothetical variable, "varname," with four possible response boxes. If the respondent selects the first two boxes in the order they appear on the form, but not the latter two boxes, varname has corresponding value "12" for that respondent. To simplify use of the data, dummy variables for each checkbox are also provided. For the preceding example, "varname_1" and "varname_2" will both be equal to one for this particular respondent and "varname_3" and "varname_4" will both be equal to zero.

In addition to responses to the items on the form, several other processing variables and flags are provided. The check-in date, or the date that the processing system last recorded updated data, is provided, as is the completion date, which is the date that the respondent reports that she completed the survey. There is no need for these two dates to be equal. The data source is provided, which allows data users to determine whether the responses were submitted as a paper form or via Centurion. There are processing variables for whether or not the seven key items are provided (response code) and whether or not the data could be matched to ASM responses at the time of tabulation. There is a variable which is set to true if the observation was used in the published tables. Both the sample weight, which is set when the sample is drawn, and the post-stratification weight, which accounts for non-response and

is used to construct the published tables, are provided. There are flags set for hand-keyed data and responses for which the respondent did not press "submit," as discussed above.

5. Conclusion

The 2010 MOPS was the first-ever large survey of management practices at manufacturing establishments in the United States. The Census Bureau fielded a second wave of the MOPS for reference year 2015. In both years, the Census Bureau issued the MOPS as a supplement to the ASM, but due to its unique content, the MOPS collection strategy differed from the ASM collection strategy in key ways. For example, this paper details the important mail and collection strategies used for the MOPS and differences in the collection and processing of the MOPS over two survey waves.

This paper also details the paper and electronic collection technologies for the MOPS, as well as the impacts that these technologies may have had on the reported data. Additional research is necessary to determine whether there are other systematic differences between respondents who complete the MOPS electronically and those who complete the paper form.

The Census Bureau processed the 2015 MOPS in a manner similar to many of its other surveys, using the StEPS II processing system. The Census Bureau performed simple imputation and derivation on the submitted data to yield results that are interpretable by data users and generate meaningful measures of management. The Census Bureau released statistics from this imputed data and the related derived items in the form of official tables.

Furthermore, the Census Bureau makes MOPS data available to researchers on approved projects through the FSRDC network following the validation of the data. This validation provides additional information on the value of the MOPS data to the public and the research community. Validation of the MOPS also includes consideration of how the Census Bureau can publish official statistics from data beyond Section A of the survey for future survey waves.

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US Census Bureau. (2016). *2015 Management and Operational Practices Survey Matrix*.

Table 1. MOPS Mail Schedules

Table 1.a. MOPS 2015

Mailing	Mail out Type	File Creation Dates	Mail Dates
ASM Sample Selection	-	(Data was extracted from BR the night of Jan 02, 2016)	Jan 2016-
Initial Mail	Letter, Flyer & Form	Jan 02, 2016	4/28/2016
Due Date Reminder	Letter Only	5/27/2016	6/10/2016
1st Follow-up Mail	Letter Only	6/27/2016	7/11/2016
UAA Mailing	Letter, Flyer & Form	6/27/2016	7/11/2016
2nd Follow-up Mail	Letter Only	8/8/2016	8/22/2016
UAA Follow-up Mailing	Letter Only	8/8/2016	8/22/2016
Paper Close-out	-	9/30/2016	-
Electronic Close-out	-	10/31/2016	-

Table 1.b. MOPS 2010

Mailing	Dates
ASM Sample Selection	10/2010
Initial Mail	4/11/2011
1st Follow-up Mail	6/13/2011
1st Follow-up Re-mail	7/13/2011
2nd Follow-up Mail	7/27/2011
UAA Re-mail	8/18/2011
2nd Follow-up Mail, Phase II	8/23/2011
MOPS Close-out	2/15/2012

Table 2. KFI Constraints

Variable Type	Rules applied
Text box	Character set ['0'..'9','A'..'Z','&','#','-','/','\','?','@','`','_','^','!','*','$','(',')','[',']','|','<','>',':',';','.',',','%'] Length (varies by field)
Dollar value	Character set [0,…,9] Length [0,…,8]
Percent	Character set [0,…,9] Length [0,…,3] Range [0,…,100]
Quantity	Character set [0,…,9] Length (varies by field)
Year	Character set [0,…,9] Length [4]

Source: US Census Bureau. (2016). *2015 Management and Operational Practices Survey Matrix*.

Table 3. KFI Flags

Type of flag	Value	Description
Item	1	Bracketed data
Item	2	Altered Stub
Item	3	Coverage
Item	4	Other
Page		

Source: US Census Bureau. (2016). *2015 Management and Operational Practices Survey Matrix*.

Table 4. Summary of Edits and Machine-Edited Data Actions by Question

Question	Edit 1	Edit 1 action	Edit 2	Edit 2 action	Edit 3	Edit 3 action	Edit 4	Edit 4 action
1	Mark one	Select most structured						
2	Mark one	Select most structured			Skip with reported data	(none)	Skip with no reported data	Set 3,4,5 to lea structured
3			Mark all	Select most structured				
4			Mark all	Select most structured				
5	Mark one	Select most structured						
6	Mark one	Select most structured			Skip with reported data	(none)	Skip with no reported data	Set 7,8,9,10,11, to least structu
7	Mark one	Select most structured						
8	Mark one	Select most structured						
9			Mark all	Select most structured	Skip with reported data	(none)	Skip with no reported data	Set 10 to least structured
10	Mark one	Select most structured						
11			Mark all	Select most structured	Skip with reported data	(none)	Skip with no reported data	Set 12 to least structured
12	Mark one	Select most structured						
13	Mark one	Select most structured						
14	Mark one	Select most structured						
15	Mark one	Select most structured						
16	Mark one	Select most structured						

Notes: It is assumed that edit one runs before edit two and edit two runs before edit three, item edits run in question order, edit flags are set and then actions are taken to created machine edits, and derived items run after edit flags are set and machine edit changes are executed. Separate and identical sets of edits, actions, and derived items are constructed for both the current and prior period (2015 response data and 2010 recall data).

Table 5. Monotonic Rankings of MOPS Questions

Question Number	Response	Monotonic Score
1	We fixed it but did not take further action	1/3
1	We fixed it and took action to make sure that it did not happen again	2/3
1	We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance	1
1	No action was taken	0
2	1-2 key performance indicators	1/3
2	3-9 key performance indicators	2/3
2	10 or more key performance indicators	1
2	No key performance indicators	0
3	Yearly	1/6
3	Quarterly	1/3
3	Monthly	1/2
3	Weekly	2/3
3	Daily	5/6
3	Hourly or more frequently	1
3	Never	0
4	See question 3	See question 3
5	All display boards were located in one place (e.g. at the end of the production line)	1/2
5	Display boards were located in multiple places (e.g. at multiple stages of the production line)	1
5	We did not have any display boards	0
6	Main focus was on short-term (less than one year) production targets	1/3
6	Main focus was on long-term (more than one year) production targets	2/3
6	Combination of short-term and long-term production targets	1
6	No production targets	0
7	Possible to achieve without much effort	0
7	Possible to achieve with some effort	1/2
7	Possible to achieve with normal amount of effort	3/4
7	Possible to achieve with more than normal effort	1
7	Only possible to achieve with extraordinary effort	1/4
8	Only senior managers	0
8	Most managers and some production workers	1/3
8	Most managers and most production workers	2/3
8	All managers and most production workers	1

Question Number	Response	Monotonic Score
9	Their own performance as measured by production targets	1
9	Their team or shift performance as measured by production targets	3/4
9	Their establishment's performance as measured by production targets	1/2
9	Their company's performance as measured by production targets	1/4
9	No performance bonuses	0
10	0%	1/5
10	1-33%	2/5
10	34-66%	3/5
10	67-99%	4/5
10	100%	1
10	Production targets not met	0
11	See question 9	See question 9
12	See question 10	See question 10
13	Promotions were based solely on performance and ability	1
13	Promotions were based partly on performance and ability, and partly on other factors (for example, tenure or family connections)	2/3
13	Promotions were based mainly on factors other than performance and ability (for example, tenure or family connections)	1/3
13	Non-managers are normally not promoted	0
14	See question 13	See question 13
15	Within 6 months of identifying non-manager under-performance	1
15	After 6 months of identifying non-manager under-performance	1/2
15	Rarely or never	0
16	See question 15	See question 15

Figure 1. Items 30 and 31 – Centurion Instrument

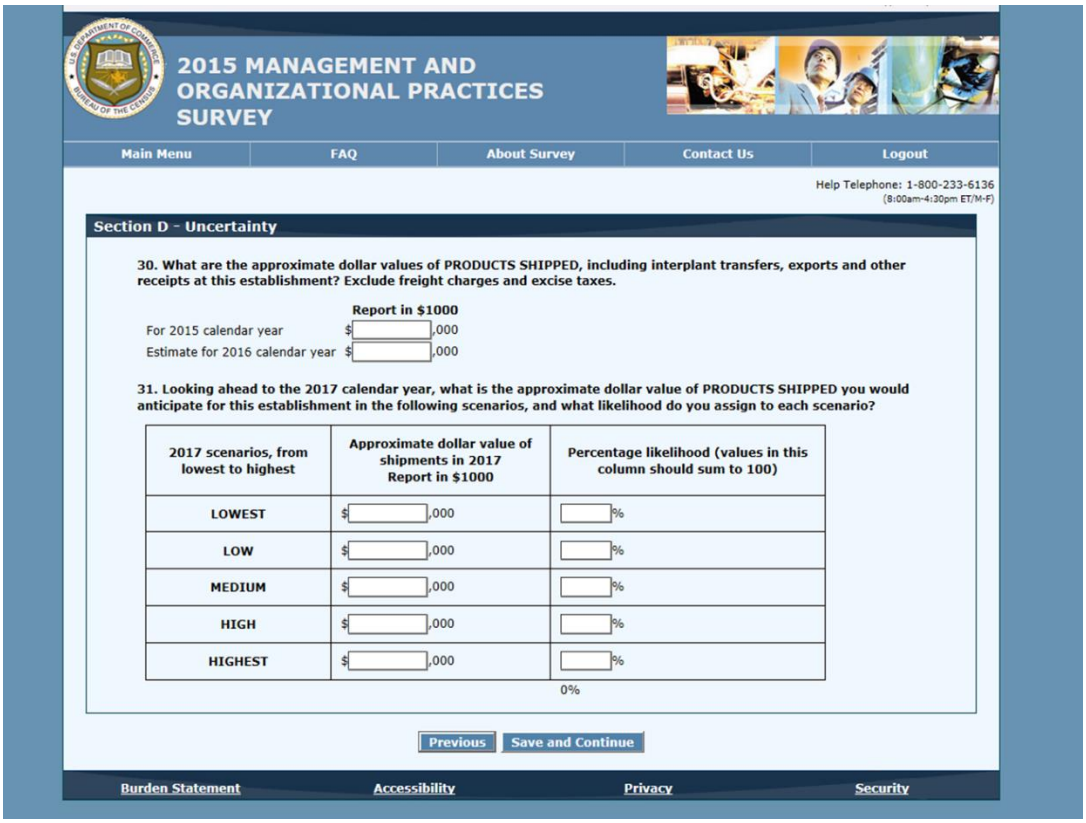
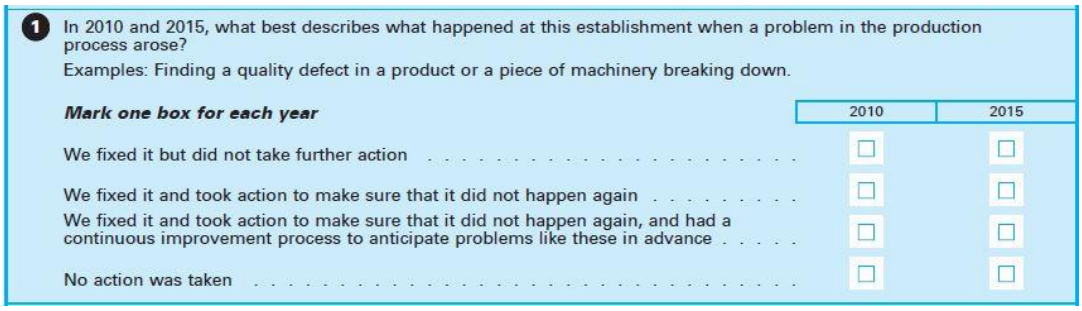


Figure 2. Item 1 – Paper Form vs. Centurion Instrument

Figure 2a. Paper Form

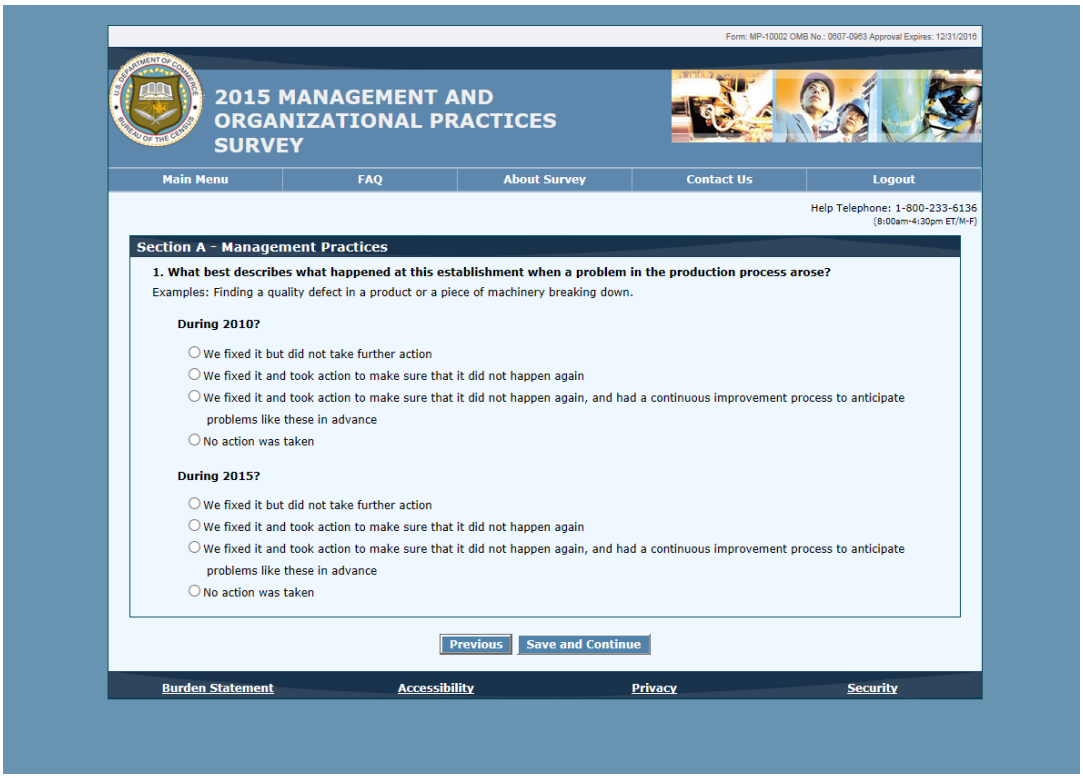


1 In 2010 and 2015, what best describes what happened at this establishment when a problem in the production process arose?

Examples: Finding a quality defect in a product or a piece of machinery breaking down.

Mark one box for each year	2010	2015
We fixed it but did not take further action	☐	☐
We fixed it and took action to make sure that it did not happen again	☐	☐
We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance	☐	☐
No action was taken	☐	☐

Figure 2b. Centurion Instrument



Form: MP-10002 OMB No.: 0607-0963 Approval Expires: 12/31/2016

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Section A - Management Practices

1. What best describes what happened at this establishment when a problem in the production process arose?

Examples: Finding a quality defect in a product or a piece of machinery breaking down.

During 2010?

- ○ We fixed it but did not take further action
- ○ We fixed it and took action to make sure that it did not happen again
- ○ We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance
- ○ No action was taken

During 2015?

- ○ We fixed it but did not take further action
- ○ We fixed it and took action to make sure that it did not happen again
- ○ We fixed it and took action to make sure that it did not happen again, and had a continuous improvement process to anticipate problems like these in advance
- ○ No action was taken

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Figure 3. Items 27 and 28 – Paper Form vs. Centurion Instrument

Figure 3a. Paper Form

27 a) Consider each of the following sources of data and rate how frequently each source was used in decision making at this establishment **in 2015**.

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Performance indicators from production technology or instruments	☐	☐	☐	☐	☐
Formal or informal feedback from managers	☐	☐	☐	☐	☐
Formal or informal feedback from production workers	☐	☐	☐	☐	☐
Data from outside the firm (suppliers, customers, outside data providers)	☐	☐	☐	☐	☐

b) Now think back to five years ago. How frequently was each source of data used in decision making at this establishment **in 2010**?

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Performance indicators from production technology or instruments	☐	☐	☐	☐	☐
Formal or informal feedback from managers	☐	☐	☐	☐	☐
Formal or informal feedback from production workers	☐	☐	☐	☐	☐
Data from outside the firm (suppliers, customers, outside data providers)	☐	☐	☐	☐	☐

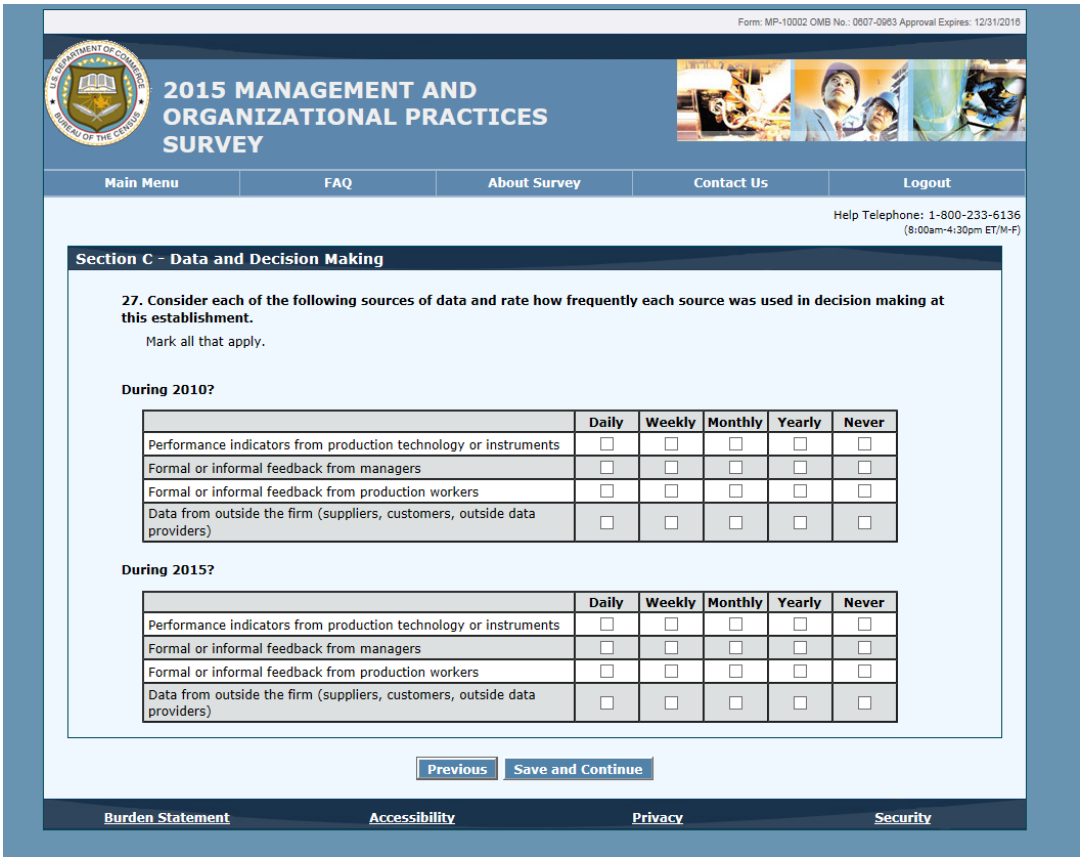
28 a) How frequently was each of these activities influenced by data analysis at this establishment **in 2015?**

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Design of new products or services	☐	☐	☐	☐	☐
Demand forecasting	☐	☐	☐	☐	☐
Supply chain management	☐	☐	☐	☐	☐

b) Now think back to five years ago. How frequently was each of these activities influenced by data analysis at this establishment **in 2010**?

Mark all that apply	Daily	Weekly	Monthly	Yearly	Never
Design of new products or services	☐	☐	☐	☐	☐
Demand forecasting	☐	☐	☐	☐	☐
Supply chain management	☐	☐	☐	☐	☐

Figure 3b. Centurion Instrument



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Section C - Data and Decision Making

27. Consider each of the following sources of data and rate how frequently each source was used in decision making at this establishment.

Mark all that apply.

During 2010?

	Daily	Weekly	Monthly	Yearly	Never
Performance indicators from production technology or instruments	☐	☐	☐	☐	☐
Formal or informal feedback from managers	☐	☐	☐	☐	☐
Formal or informal feedback from production workers	☐	☐	☐	☐	☐
Data from outside the firm (suppliers, customers, outside data providers)	☐	☐	☐	☐	☐

During 2015?

	Daily	Weekly	Monthly	Yearly	Never
Performance indicators from production technology or instruments	☐	☐	☐	☐	☐
Formal or informal feedback from managers	☐	☐	☐	☐	☐
Formal or informal feedback from production workers	☐	☐	☐	☐	☐
Data from outside the firm (suppliers, customers, outside data providers)	☐	☐	☐	☐	☐

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Section C - Data and Decision Making

28. How frequently was each of these activities influenced by data analysis at this establishment?

Mark all that apply.

During 2010?

	Daily	Weekly	Monthly	Yearly	Never
Design of new products or services	☐	☐	☐	☐	☐
Demand forecasting	☐	☐	☐	☐	☐
Supply chain management	☐	☐	☐	☐	☐

During 2015?

	Daily	Weekly	Monthly	Yearly	Never
Design of new products or services	☐	☐	☐	☐	☐
Demand forecasting	☐	☐	☐	☐	☐
Supply chain management	☐	☐	☐	☐	☐

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Figure 4. Example Edit Language

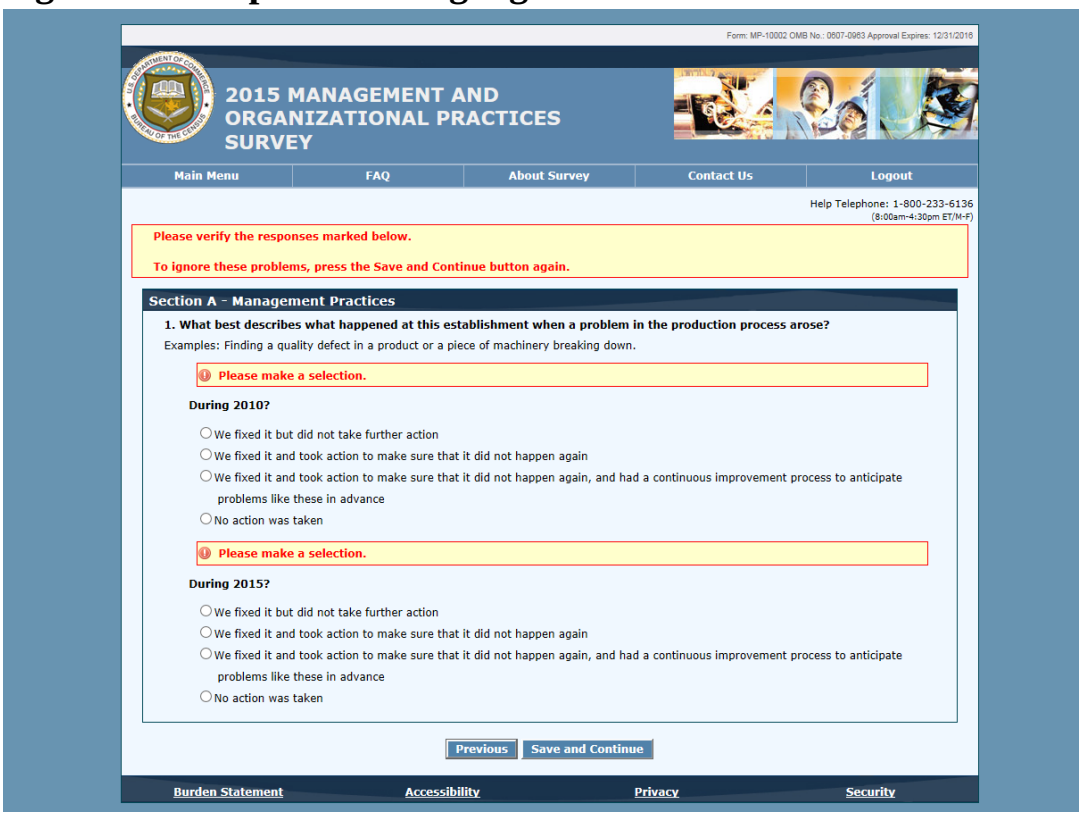
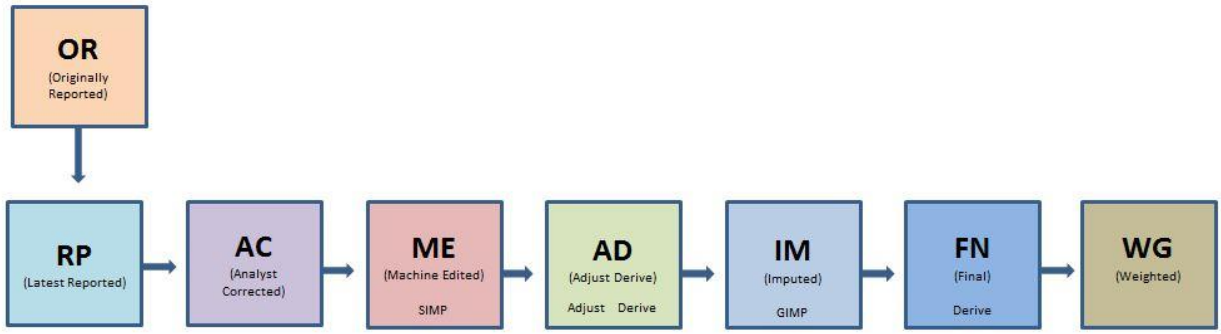


Figure 5. Data Versions



Source: StEPS II User Manual

Appendix A. MOPS 2015 Business Help Site Frequently Asked Questions

Frequently Asked Questions (FAQs)

This section answers the most frequently asked questions about the Management and Organizational Practices Survey. If you don't find an answer to your particular question, please contact staff.

- General
- Completing the Report
- Survey Definitions

Questions and Answers - by Category

General

1. What is the purpose of the Management and Organizational Practices Survey?

The U.S. Census Bureau is conducting the Management and Organizational Practices Survey to better understand current and evolving management and organizational practices and to assist in identifying determinants of establishment and productivity growth. Census data are essential for business and government decision making. Information from businesses like yours also provides reliable data for your industry and your community.

2. Is this survey mandatory?

Yes, your response is required by law. Title 13 United States Code, Sections 8(b), 131 and 182, authorizes this collection. Sections 224 and 225 require your response.

3. My company is not a manufacturer. What should I do?

If you do not manufacture products at the location shown in the address box of the report form, please indicate the nature of your business in the remarks section and return the form to us.

4. My establishment is no longer in business. What should I do?

Complete the survey with data for any period of time during the 2015 calendar year that the establishment was in operation. If the establishment was not in operation during the 2015 calendar year, please indicate that the establishment was not in business in the remarks section and return the form to us.

5. My establishment was not in business in 2010. What should I do?

If the establishment was not in operation during the 2010 calendar year, please do not report data for 2010.

6. What is the reporting period for this survey?

This survey asks about your management practices in 2010 and 2015, as well as forecasts for activity in 2016 and 2017. Report data for the calendar years in question. If calendar year book figures are not available except at considerable cost, reasonable estimates will be accepted.

7. How do I contact the Census Bureau?
If you have any questions or need further assistance, please contact staff.

8. When is the Management and Organizational Practices Survey due?
The deadline for returning data to the Census Bureau is 30 days after receiving the questionnaire or June 24, 2016, whichever occurs later.

Completing the Report

9. How do I report my data?
Instructions in PDF format for how to report data can be found at Management and Organizational Practices Survey Business Help Site.

10. How can I compile my data before reporting online?
You can get a copy of the form to compile your data before reporting online from the Forms & Letters page or by clicking on Survey Log in, entering your user ID and password, and selecting the link under the "View/Print Form as PDF" column on the main menu.

11. Where do I find the User ID and Password?
The User ID and Password are provided on the front page of the form, in the INTERNET REPORTING OPTION AVAILABLE section.

12. I lost my user ID and password. How can I access it?
If you have any questions or need further assistance, please contact staff.

13. Are online electronic services secured?
Yes. The information transferred from your computer to our server is encrypted.

14. How long will it take to complete this survey?
We estimate this survey will take an average of 45 minutes to complete, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

15. I need more time. Can I obtain an extension?
Yes. Go to Self-Service Log in, enter your unique user ID and password, select the 'Time Extension' button, and follow the instructions to select a new due date.

16. I ran out of space for comments in the Remarks section. What do I do?
If you run out of space, use the Secure Messaging Center to email the additional information.

17. Can I use estimates to complete the report form?
Estimates are acceptable when responding to the questions on this report form.

18. I was not an employee at this establishment in 2010. What should I do?

If you were not an employee at this establishment, please consult with an employee who was employed at this establishment in 2010 to assist in answering these questions. If an employee who was employed at this establishment in 2010 is not available, please answer to the best of your ability with the information available to you.

19. I do not see an answer choice that represents the situation at my establishment. What should I do?

In the event that none of the available answer choices reflect the situation at this establishment, please choose the answer that most closely represents the situation at this establishment.

Survey Definitions

20. What is an establishment/plant?

An establishment is generally a single physical location where business is conducted or where services or industrial operations are performed. For the purpose of this survey, the terms "establishment" and "plant" are synonymous.

21. What is a firm/company?

A firm is a business organization or entity consisting of one domestic establishment (location) or more under common ownership or control. All establishments of subsidiary firms are included as part of the owning or controlling firm. For the purpose of this survey, the terms "firm" and "company" are synonymous.

22. What are key performance indicators?

The following list includes examples of key performance indicators that should be considered in questions (2), (3), (4), and (5): Metrics on production, cost, waste, quality, inventory, energy, absenteeism and deliveries on time.

23. What are production targets?

The following list includes examples of production targets that should be considered in questions (6), (7), (8), (9), (10), (11), and (12): production, quality, efficiency, waste, on-time delivery.

24. What is the difference between managers and non-managers?

A manager is someone who has employees directly reporting to them, with whom they meet on a regular basis, and whose pay and promotion they may be involved with, e.g., Plant Manager, Human Resource Manager, Quality Manager.

Non-managers are all employees at the establishment who are not managers as defined above.

25. Who is an employee?

Follow the definition of an employee used on the Internal Revenue Service Form 941, Employer's Quarterly Tax Return and as described in Circular E, Employer's Tax Guide. Report

employees at the establishment who worked or received pay for the part of the pay period including the 12th of March.

INCLUDE:

- All persons on paid sick leave, paid holidays, and paid vacation during these pay periods
- Officers at this establishment, if a corporation

EXCLUDE:

- Temporary staffing obtained from a staffing service
- Members of Armed Forces or pensioners carried on your active rolls
- Proprietors and partners, if an unincorporated concern
- Agricultural workers or fishing crews from the following types of food processing establishments:
  - Sugar mills which are part of sugar plantations
  - Fruit or vegetable canning or freezing plants
  - Fish canning, freezing, or packaging plants with fishing operations associated with the plant

26. What is the value of products shipped?

Report the net selling value "free on board" (f.o.b.) plant to the customer after discounts and allowances.

EXCLUDE:

- Freight charges and excise taxes

INCLUDE:

- Products made elsewhere for this establishment by others from materials supplied by this establishment
- Receipts from products bought and resold without further processing
- The value assigned to products transferred to other plants of your company for further processing, including a reasonable portion of other costs (company overhead) and profits.

We also want to clarify the instructions for marketing high cost office and production equipment by leasing them rather than selling them. If you follow this marketing practice, report in questions (30) and (31) the value of goods marketed under lease as if you had sold them:

- Report as value of shipments the equivalent market value of the goods. (The terms of the lease may use the present discounted value or some other method.)

- Do not report any rental receipts from leases outstanding.

27. What are capital expenditures?

Report all outlays during the year for buildings and other structures, machinery, and equipment that are chargeable to the fixed asset account, and for which depreciation or amortization reserves are maintained.

INCLUDE:

- Capital expenditures (outlays) during the year that were actually made during the year, not the final value of equipment put in place or the buildings completed during the year.
  - Add the costs of additions completed during the year to the construction in progress at the beginning of year to compute capital expenditures for long-term projects in progress.
- Capital improvements or new additions in progress.
- Capital expenditures during the year for new construction whether constructed on contract or by your own work force.
- The value of all machinery and equipment, buildings, and capitalized improvements and repairs whether purchased or produced by employees of your own company.
- The value of any machinery or equipment or structure transferred to the use of this establishment by the parent company or one of its subsidiaries.

EXCLUDE

- Tools that are expensed.

28. What are materials, parts, containers, and packaging?

The following list includes examples of items which should be included in questions (36) and (37):

MATERIALS:

Lumber	Cement
Plywood	Clay
Paper	Glass
Resins	Steel sheet
Sulfuric acid	Steel scrap
Alcohols	Copper rods
Rubber	Iron castings
Coking coal	Metal stampings
Crude petroleum	Wire

PARTS:

- Pumps
- Wheels
- Bearings
- Engines
- Gears
- Motors
- Hardware
- Compressors

CONTAINERS:

- Pails
- Drums and barrels
- Tubes
- Boxes and bags
- Crates

SUPPLIES:

- Bolts, screws, and nuts
- Drills, tools, dies, jigs, and fixtures which are charged to current accounts
- Welding rods, electrodes, and acetylene
- Lubricating oils
- Cleaning supplies
- Stationary and office supplies
- First aid and safety supplies
- Dunnage
- Water