

# Outside the Answer Boxes: Messages from Respondents

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## Abstract

The Business R&D and Innovation Survey, conducted jointly by the U.S. Census Bureau and the National Science Foundation (NSF), is mailed annually to 40,000 businesses. In 2008, a redesigned version of the questionnaire increased the number of pages for the long form from 18 to 56. The short form increased from 7 to 28 pages. We received 1,467 paper questionnaire responses and 2,446 web responses for the 2008 long form. As part of the evaluation of data quality produced by the redesigned questionnaire, we coded the extraneous information that respondents wrote on the paper survey forms. That is, we coded any information written outside the answer boxes. These messages from respondents included such things as strikeouts of categories, notations that questions were not applicable, and strikeouts of entire questions or pages of questions.

This paper examines the usefulness of this coding of paper responses for evaluating the design of a new questionnaire. We provide examples of messages from respondents concerning (1) data quality issues, (2) questionnaire design flaws, (3) data availability issues, and (4) interpretation of the content of the question. We also provide examples of data analyses that can be used to augment the information gleaned from respondent messages to provide a more rigorous tool for evaluating survey design.

Note: This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. Any views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau or the National Science Foundation.

**Key Words:** coding, questionnaire evaluation, respondent messages, data quality, data availability, questionnaire design, survey design

## 1. Background

There is little, if any, research that looks at what respondents write outside the answer boxes on paper surveys. Survey research was long dominated by telephone surveys where interviewers record respondent comments. Today, the web survey has become the successor in attracting researchers. Web surveys rarely offer spaces for respondents to provide comments. Thus, respondent feedback is often limited to questionnaire testing. Mail surveys, however, often provide lots of space for actual respondents to provide feedback on survey questions. In particular, they can express frustration with trying to fit their situation into a question's response options. This feedback is lost as we move

surveys to the Web. Since comment boxes are not usually placed on every screen, respondents do not have an easy way to provide similar feedback.

The questions and answers of a survey form a conversation between the respondent and the interviewer. Sudman, Bradburn, and Schwarz (1996, p. 62) apply Paul Grice's philosophy of the assumptions that underlie this conversation. They posit that respondents infer the meaning of questions through principles that apply to conversations such as the "cooperativeness" principle. They describe Grice's "maxim of manner" as the assumption by listeners in a conversation that communications will be clear and unambiguous. They describe Grice's "maxim of relation" as the assumption by listeners that the speaker will make a relevant contribution. In the case of mail surveys, or other surveys using paper questionnaires, respondents can provide comments in the margins to make their side of the conversation more meaningful and relevant. In the case of web surveys, we often limit the respondent's ability to hold up their side of the conversation.

Research by Christian and Dillman (2004) showed that larger areas for answer boxes on mail surveys encourage respondents to write longer answers with more words. The continuation of this research on web surveys showed that providing larger spaces increased the length of answers only for the survey's later responders (Smyth et al, 2009). This literature seems to indicate that we can encourage communication from respondents. We make the argument that we need to encourage more communication from respondents so that they can comment on their survey answers.

In this paper, we look at the messages that respondents wrote on the paper form for the 2008 Business R&D and Innovation Survey (BRDIS). This annual survey is conducted jointly by two agencies of the United States government, the Census Bureau and the National Science Foundation. The survey has been conducted annually since 1953, formerly as the Survey of Industrial Research and Development. The 2008 survey was mailed in early 2009 to nearly 40,000 businesses nationwide (Wolfe, 2010). These businesses were sampled to represent the population of nearly 2 million U.S. businesses, publicly or privately held, with five or more employees. Businesses designated as high performers of R&D from previous data collections received a long form (BRDI-1). The rest of the sample received the short form (BRDI-1A). This paper discusses only our experiences with the long form, which was mailed to about 5,000 businesses.

A major redesign of the survey was launched for the 2008 survey (Wolfe, 2008). An expert panel was convened in 2006 to examine the issues for today's world that needed to be considered in redesigning the survey. Census and NSF managers and survey managers began meeting as a steering committee to discuss operational issues, develop survey content and definitions, and to design sampling strategy.

One topic of discussion by the steering committee was whether the survey would continue to use the mail mode of survey administration to contact respondents. Due to the strict requirements of confidentiality and the known security issues with the Internet, policy dictates that the survey will continue to be initially sent through the mail. However, respondents would continue to receive user IDs and passwords to allow them to respond to the survey via a secure website.

The 2008 survey was updated with new content that expanded the number of questions in the survey form. In addition, the previous instruction booklet was scrapped in favor of designing a user-friendly questionnaire that incorporated survey definitions. Professor

Don Dillman of Washington State University provided continuing assistance in the design of the questionnaire. This paper's authors were also involved in the design of the form as well as five rounds of face-to-face cognitive testing of the questionnaire.

The new questionnaire booklet for the long form more than doubled the size of the previous questionnaire from 18 to 56 pages. The number of questions increased from 20 to 102 questions. Some of the increase in questions was due to breaking down old questions to make them easier to read, understand, and complete.

The new questionnaire booklet was organized into six sections that were color coded for the long form. The beginning of each section included materials to focus on the selection of the correct respondent for that set of questions. The materials included suggestions for the appropriate departments of a company for locating survey answers.

As data collection proceeded during 2009, several evaluation activities took place. Foremost was the effort to either call or visit respondents from the largest 500 companies to discuss data collection for the new survey form. To prepare for these contacts, comparisons were made to other data such as reports that a company submitted to the U.S. Securities and Exchange Commission (SEC). Incoming calls to the survey help desk were also logged to look for issues that might affect the quality of the data collected. After companies submitted their survey responses, some were selected for in-person debriefing interviews to discuss their reactions to the newly redesigned survey.

Other evaluation activities included statistical analyses of unit and item nonresponse. Computerized edit checks were implemented to compare answers to the 2007 survey as well as to check for consistency across the 2009 survey answers. An analysis of later responders was also conducted.

One of the evaluation projects was a coding system to capture the frequency of respondent messages written on all survey forms submitted on paper (either returned in the mail or faxed). The forms of these 1,467 respondents were scanned into a database for data entry. Another 2,446 respondents submitted their survey response via the web using a template designed to mirror the paper version they received in the mail. These respondents were not included in the coding project.

Staff keyed survey answers from the images of the paper pages. During these sessions, they also entered codes for each page to describe whether respondents had written non-standard answers or comments or other marks outside the answer boxes, such as strikeouts. We consider all these marks as messages from respondents. This evaluation project was designed to see if we could learn anything from such messages.

## **2. Hypotheses**

Our hypotheses for this project included four themes. First, we expected to discern data quality issues from these messages. It is common on paper survey forms for respondents to fill in the answer but then write a comment to explain that they are reporting something somewhat different from the attribute described. Data mismatches are especially common for business surveys where records may not match the survey measurement.

A second hypothesis was that we expected to see comments about flaws in the design of the questionnaire. For example, a respondent might write in a comment that shows that the skip pattern logic does not work properly.

A third hypothesis was that respondents would comment on data availability issues. Such comments can help explain item nonresponse. Did the respondent have the data? Was the burden too high to compile the data?

Our fourth hypothesis was that we could use the respondent messages to help quantify which survey items needed attention. Perhaps the quantity of messages could predict which items had the most and least problems for respondents.

### **3. Method**

Data entry staff keyed the page number for each respondent message. Staff coded the page as having a message if the respondent wrote anything on the page outside the answer boxes. They used a code to identify the type of message written by the respondent.

We obtained a dataset with the respondent identification number, the page number for the message, and the message code. We looked at the frequency counts of messages for each page to sort the page numbers from highest to lowest based on counts of messages. Using this ranking, we selected respondents from the list who had errors on the pages with the highest counts. Then, we pulled up selected respondent's forms on the computer screen to look at the scanned images from the pages with the most messages. We reviewed messages to identify patterns of messages both within single page numbers and across page numbers. We identified themes to describe these patterns.

This method is qualitative. The frequency of messages was not our focus. The messages are used to generate hypotheses for subsequent quantitative analyses of the survey data.

### **4. Findings**

Typically, survey designers offer an open-ended "Remarks" box at the end of the questionnaire to elicit comments from the respondent. Because this item appears last, respondents may or may not have the energy and motivation to offer comments at this point. Our hope for the analysis of respondent messages was that we could gather additional comments that would not be remembered or reported by the time the respondent saw the Remarks section at the end of the survey.

The questionnaire for the 2008 survey provided a large white box for comments that covered about 50 percent of the space on the back cover. To encourage respondents to use this Remarks box, the last two pages of the questionnaire were blank with the following instruction. (See Figure 1.)

Provide your comments in the space for "Remarks" on the back cover.

Of the 1,467 paper responses, 94 (less than one in 16) provided a comment in the Remarks section on the last page (back cover) of the survey. In the past, the survey form had instructed respondents to use this section to provide information about changes in the

company ownership, so one might see a comment on the form such as “My company was purchased in June 2008.” [Note: No actual quotes are used in this paper due to confidentiality issues.]

**Figure 1:** The Remarks section for the 2008 Business R&D and Innovation Survey

In contrast, our count of respondent messages showed 1,627 messages for the rest of the questionnaire. This result leads us to believe that we found additional information by coding respondent messages outside of the answer boxes.

Table 1 shows frequencies for the five pages with the highest counts of messages. These five pages represented 797 messages, or over half of the total messages.

**Table 1:** Highest Counts Per Page

Page number	Number of messages
6	551 (Section 1)
27	97 (Section 3)
24	62 (Section 3)
46	44 (Section 6)
45	43 (Section 6)
	<hr/> 797 (54 % of total)

The high count for page 6 was due to respondents crossing out pre-printed business codes to add more correct business codes, per the instructions. We reviewed the remaining pages to see if we could find patterns among the comments.

We found five types of messages in the pages we reviewed.

#### **4.1 Message: Question does not apply**

The first type of message let us know that the question does not apply to the respondent’s company. The form of this message varied greatly, but the message was unambiguous.

Some wrote words such as “This section not applicable” or “N/A.” (See Figure 2.) Others drew a line through the material that they did not consider to apply to their company. For those who used lines to express their message, some drew a line through an item. Others drew lines through answer boxes. Still others drew a line through an entire page. Some respondents wrote a note explaining why the question does not apply to their company.

**3•19** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3•2 involved science/technology that your company had not used in projects before 2008?

**Example:** Company F is an automobile manufacturer. In 2008, it began to explore using hydrogen fuel cells in its vehicles at its U.S. R&D facility. Because Company F had not used this technology before 2008, it is new for the company. The costs for this R&D are included in the calculation for this question.

Percent	
0	%

n/a

**Figure 2:** Respondent’s Message that a Question Does Not Apply

Interestingly, some of these respondents lined out items that they were instructed to skip. We surmise that there are multiple reasons why the respondent might cross out inapplicable questions. They might do it to remind themselves that they do not need to revisit this item. Or, they may do it to indicate to a reviewer that the question does not need to be addressed by their company. We also think that they want to indicate to NSF and the Census Bureau that they addressed each question. Many of these respondents are accountants. On the basis of cognitive interviews we’ve conducted with these respondents, we suspect that they like to address every question, even if they’ve been told to skip several pages.

Figures 3 and 4 show two examples from the range of strategies respondents used to communicate their messages that questions did not apply. Some notations were more subtle; some were more explicit. These figures are representations of typical patterns rather than actual scanned pages from respondents that would include identification numbers. In some cases, the respondent simply draws a line through the entire page to indicate that their company is skipping that page. In Figure 3, we see another version of that pattern where respondents added the notation, “n/a,” to their line to show the reason for the line. Figure 4 shows another pattern we observed that combines lining through a series of the answer boxes as well as noting “n/a.”

Some respondents went to great lengths to explain why they skipped a question. These explanations could indicate frustration with the design of the questionnaire. Figure 5 shows the type of comments we saw in pointing out that a question could not reasonably be answered. Question 3-16 asks respondents to split a number reported in Question 3.2 into two percentages that add to 100 percent. If a respondent reported a zero in Question 3.2, it does not make sense to provide percentages. Furthermore, there is no way that a respondent can indicate that the question does not apply when addressing Question 3-16. This explanation is helpful in giving feedback on the design of our questionnaire. Other respondents simply wrote “n/a” in the answer for the same situation, which required more assumptions on our part as to what the respondent thought.

Figure 6 shows a similar issue for respondents. The question asks respondents to give details on their answer to an earlier question. This time, Question 3-14 asked a series of

yes/no questions about the new agreements that the respondent reported in Question 3-13. This respondent left the question blank, but wrote,

The answer to Question 3.13 is zero so “no” is misleading.

Many other respondents may have decided that “no” was the appropriate answer.

The image shows a survey page titled "Characteristics of domestic R&D performed by your company that was part of your R&D expense". It contains five questions (3-16 to 3-20) with response grids. A large blue "N/A" is written diagonally across the entire page, indicating that the respondent did not answer any of these questions.

**Characteristics of domestic R&D performed by your company that was part of your R&D expense**

For questions 3-16 through 3-20, the reported amounts exclude R&D funded or paid by others, which is reported in Section 4.

**3-16** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was for the following categories?

a. <u>Research</u> —planned, systematic pursuit of new knowledge of understanding	Percent	%
b. <u>Development</u> —systematic use of research and practical experience to produce new or significantly improved goods, services, or processes		%
c. Total	100	%

**3-17** If you reported any research in Question 3-16, line a, what percentage of that research was for the following categories?

a. <u>Applied research</u> —activity aimed at solving a specific problem of meeting a specific commercial objective	Percent	%
b. <u>Basic research</u> —activity aimed at acquiring new knowledge of understanding without specific immediate commercial application of use		%
c. Total	100	%

**3-18** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was directed toward business areas or product lines in which your company had no revenues before 2008?

**Example:** Company E is an automobile manufacturer. In 2008, it began R&D at its U.S. facilities on the company's first motorcycle. Because Company E had no previous revenues for motorcycles, it is a new business area for this company. The costs for this R&D are included in the calculation for this question.

Percent	%
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**3-19** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 involved science/technology that your company had not used in projects before 2008?

**Example:** Company F is an automobile manufacturer. In 2008, it began to explore using hydrogen fuel cells in its vehicles at its U.S. R&D facility. Because Company F had not used this technology before 2008, it is new for this company. The costs for this R&D are included in the calculation for this question.

Percent	%
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**3-20** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was both directed toward business areas or product lines in which your company had no revenues before 2008 and involved science/technology that had not been used by your company in other projects before 2008?

**Example:** Company G is an automobile manufacturer. In 2008, it began a project to develop the company's first motorcycle. At the same time, G begins to explore using hydrogen fuel cell technology in its vehicles—including motorcycles—at its U.S. R&D facility. Because motorcycle manufacturing is a new business area for G and the company had no experience with hydrogen fuel cell technology before 2008, it would include the hydrogen fuel cell R&D related to its motorcycle project in the calculation for this question.

Percent	%
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**Figure 3:** Respondent’s Message showing that an Entire Page of Questions Does Not Apply

**Characteristics of domestic R&D performed by your company that was part of your R&D expense**

For questions 3-16 through 3-20, the reported amounts exclude R&D funded or paid by others, which is reported in Section 4.

N/A

**3-16** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was for the following categories?

	Percent
a. <u>Research</u> —planned, systematic pursuit of new knowledge or understanding. . . .	%
b. <u>Development</u> —systematic use of research and practical experience to produce new or significantly improved goods, services, or processes. . . . .	%
c. Total. . . . .	1 0 0 %

**3-17** If you reported any research in Question 3-16, line a, what percentage of that research was for the following categories?

	Percent
a. <u>Applied research</u> —activity aimed at solving a specific problem of meeting a specific commercial objective . . . . .	%
b. <u>Basic research</u> —activity aimed at acquiring new knowledge of understanding without specific immediate commercial application of use . . . . .	%
c. Total. . . . .	1 0 0 %

**3-18** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was directed toward business areas or product lines in which your company had no revenues before 2008?

*Example:* Company E is an automobile manufacturer. In 2008, it began R&D at its U.S. facilities on the company's first motorcycle. Because Company E had no previous revenues for motorcycles, it is a new business area for the company. The costs for this R&D are included in the calculation for this question.

	Percent
	%

**3-19** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 involved science/technology that your company had not used in projects before 2008?

*Example:* Company F is an automobile manufacturer. In 2008, it began to explore using hydrogen fuel cells in its vehicles at its U.S. R&D facility. Because Company F had not used this technology before 2008, it is new for the company. The costs for this R&D are included in the calculation for this question.

	Percent
	%

**3-20** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was both directed toward business areas or product lines in which your company had no revenues before 2008 and involved science/technology that had not been used by your company in other projects before 2008?

*Example:* Company G is an automobile manufacturer. In 2008, it began a project to develop the company's first motorcycle. At the same time, G begins to explore using hydrogen fuel cell technology in its vehicles—including motorcycles—at its U.S. R&D facility. Because motorcycle manufacturing is a new business area for G and the company had no experience with hydrogen fuel cell technology before 2008, it would include the hydrogen fuel cell R&D related to its motorcycle project in the calculation for this question.

	Percent
	%

Figure 4: Respondent's Message that a Series of Questions Do Not Apply

**3-16** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was for the following categories?

	Percent
a. <u>Research</u> —planned, systematic pursuit of new knowledge or understanding. . . .	%
b. <u>Development</u> —systematic use of research and practical experience to produce new or significantly improved goods, services, or processes. . . . .	%
c. Total. . . . .	1 0 0 %

My answer to Question 3.2 is zero.  
You cannot take percents of zero and make them add to 100 percent.

Figure 5: Respondent's Message that a Question Does Not Apply



**3•14** Did the new R&D agreements reported in Question 3•13 involve agreements with the following types of organizations?

*The answer to Question 3.13 is zero so "no" is misleading*

a. For-profit companies located inside the United States .....  Yes  No

b. For-profit companies located outside the United States .....  Yes  No

c. U.S. federal government agencies or laboratories. ....  Yes  No

d. Universities, colleges, and academic researchers, including individual principal investigators. ....  Yes  No

e. Foreign government agencies or laboratories. ....  Yes  No

**Figure 6:** Respondent’s Message that a Yes/No Question Does Not Apply

In some cases, a respondent’s message would conflict with their survey answer. Figure 7 shows an example of this. The respondent writes a zero in answering Question 3.19 about the percentage of their R&D from Question 3.2 that involved new science or technology never used before. However, the respondent also writes “n/a” to indicate that the question does not apply. This was due to the respondent’s answer of zero to Question 3.2. Our edit checks would clean the dataset when we check for such situations. However, we add to respondent burden by asking them to complete items that do not apply. Respondents must spend time to think up a strategy to let us know that they should not be answering the question.

**3•19** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3•2 involved science/technology that your company had not used in projects before 2008?

**Example:** Company F is an automobile manufacturer. In 2008, it began to explore using hydrogen fuel cells in its vehicles at its U.S. R&D facility. Because Company F had not used this technology before 2008, it is new for the company. The costs for this R&D are included in the calculation for this question.

Percent
0 %

*n/a*

**Figure 7:** Respondent’s Message that Overrides Their Answer

**4.2 Message: Answer is Unknown**

Other respondents wrote messages to let us know that they did not have an answer for a question. Some wrote only a question mark. Others wrote a note such as, “data not readily available.” These respondents were trying to let us know that they did not have the information requested rather than leaving the item blank. This information would be preferable to an answer of zero by a respondent in the same situation. Again, some respondents may add such notes for themselves, for a reviewer, or for NSF and Census.

### 4.3 Message: Reported Data Have Problems

Respondents also wrote messages that let us know that the answers they provided had problems. In some cases, they seemed to indicate that they provided an answer, but that they felt they probably should have left the item blank. Figure 8 shows another example of the respondent overriding an answer of zero. This time, the respondent is saying that the data are not readily available. However, the respondent has provided an answer of zero. We still don't know if the answer is actually zero or not because the respondent has not been able to find sources for the answer. Perhaps zero is a best guess; perhaps not.

3•13 In 2008, how many new R&D agreements did your company enter into?

Number
0

*data not readily available*

**Figure 8:** Another Respondent's Message Overrides the Data Provided

Another situation is common for surveys that request numbers. On a paper survey, the respondent writes a range such as 50-100 to indicate that an answer is just an estimate. While this message from the respondent is technically "inside" the answer box, it is outside the answer box as far as data entry staff are concerned. On the web version of the survey, this same respondent would have to provide an exact number because this data field would only accept a number. As we move away from paper surveys towards the web, we lose the ability to let respondents communicate the quality of their numeric answers. Figure 9 shows a related message we observed. In this case, the respondent put an exact number in the answer box, but wrote "(estimate)" underneath. The fact that the answer was a rounded number, 100, might have been a clue that the number is an estimate. Here, we will have an answer in the survey's database, but the quality of that answer is not what we want.

3•13 In 2008, how many new R&D agreements did your company enter into?

Number
100

*(estimate)*

**Figure 9:** Respondent's Message indicates that Reported Data Have Problems

In another situation, respondents let us know that our answer categories did not allow them to provide the exact answer they preferred. At the end of Section 6, we asked respondents how long it took to complete the section. The answer box was labeled, "Hours." One respondent wrote, "<1" to answer the question and let us know that they did not spend a whole hour. Unfortunately, this is not an answer that the data entry staff could handle. Nevertheless, the message lets us know that respondents' data have problems. Another "message" from the respondent was coded by data entry staff when a respondent wrote "1.5" to answer the same question. We're not sure if this answer might actually have been miscoded as a "15." This issue was resolved in later years by allowing respondents to report tenths of an hour.

### 4.4 Message: Too Much Effort to Answer Individually

Another type of respondent message seemed to communicate that the questions required too much effort to answer. Figure 10 shows a creative way that one respondent indicated that the answers were zero to a series of questions on page 25. Another respondent drew a line through the answers boxes on this page and wrote a large “0” at the top of the line. Another respondent used a similar strategy with the word “none” at the top of the line. In all of these situations, respondents actually had answered “zero” to Question 3-2 so that none of these questions actually applied to their company. However, they assumed that they should put in answers, but it was too much trouble to provide them individually.

**Characteristics of domestic R&D performed by your company that was part of your R&D expense**

For questions 3-16 through 3-20, the reported amounts exclude R&D funded or paid by others, which is reported in Section 4.

**3-16** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was for the following categories?

	Percent
a. <u>Research</u> —planned, systematic pursuit of new knowledge of understanding. . . .	<input type="text"/> %
b. <u>Development</u> —systematic use of research and practical experience to produce new or significantly improved goods, services, or processes. . . .	<input type="text"/> %
c. Total. . . .	1 0 0 %

**3-17** If you reported any research in Question 3-16, line a, what percentage of that research was for the following categories?

	Percent
a. <u>Applied research</u> —activity aimed at solving a specific problem of meeting a specific commercial objective. . . .	<input type="text"/> %
b. <u>Basic research</u> —activity aimed at acquiring new knowledge of understanding without specific immediate commercial application of use. . . .	<input type="text"/> %
c. Total. . . .	1 0 0 %

**3-18** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was directed toward business areas or product lines in which your company had no revenues before 2008?

**Example:** Company E is an automobile manufacturer. In 2008, it began R&D at its U.S. facilities on the company's first motorcycle. Because Company E had no previous revenues for motorcycles, it is a new business area for this company. The costs for this R&D are included in the calculation for this question.

	Percent
	<input type="text"/> %

**3-19** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 involved science/technology that your company had not used in projects before 2008?

**Example:** Company F is an automobile manufacturer. In 2008, it began to explore using hydrogen fuel cells in its vehicles at its U.S. R&D facility. Because Company F had not used this technology before 2008, it is new for the company. The costs for this R&D are included in the calculation for this question.

	Percent
	<input type="text"/> %

**3-20** What percentage of the domestic R&D performed by your company in 2008 reported in Question 3-2 was both directed toward business areas or product lines in which your company had no revenues before 2008 and involved science/technology that had not been used by your company in other projects before 2008?

**Example:** Company G is an automobile manufacturer. In 2008, it began a project to develop the company's first motorcycle. At the same time, G begins to explore using hydrogen fuel cell technology in its vehicles—including motorcycles—at its U.S. R&D facility. Because motorcycle manufacturing is a new business area for G and the company had no experience with hydrogen fuel cell technology before 2008, it would include the hydrogen fuel cell R&D related to its motorcycle project in the calculation for this question.

	Percent
	<input type="text"/> %

**Figure 10:** Respondent’s Message that It is Too Much Effort to Fill in Zeroes for a Series of Answers

#### 4.5 Message: Notes to Self and/or Others

We observed that some respondents wrote messages directed at themselves or to an internal company reviewer, such as a supervisor. Perhaps some of these notes were actually directed to the Census and NSF to let us know the source of information for their answers. One message we saw showed the respondent's calculation of an answer with a series of numbers adding to the total reported. Another message stated the source for the medical trial information.

In one case, we saw a message that seemed to be geared to an internal reviewer: "(Asked Bob in Legal)." In another case, we saw a message that seemed to come from the reviewer: (Where did this number come from?)." Another time, we saw initials next to an answer that was crossed out and replaced with another answer. This message seemed to be directed at the respondent or someone else within the company.

In one case, we observed just the simple circling of the instruction to "Skip to Section 6, page 49." This could be either a reminder for the respondent or an observation directed to the internal reviewer.

In some cases, we weren't sure if the message was for Census and NSF or for an internal company reviewer. Figure 11 shows the effort a respondent made to let us know that they did their best to answer the question. They put a zero in the answer box. Then, they wrote "n/a" to say the question did not apply to their company. But, then, they went even one step more to write, "No outside funding" to let us know that they understood the question that asked:

**What were your company's total worldwide costs in 2008 for R&D that was funded or paid for by others not owned by your company?**

Because the answer to this question ultimately determines whether a company completes Section 4 of the questionnaire, perhaps the respondent felt it was especially important to document their reasoning for an answer of zero. We note that the following question was completed only in part—a zero on the first of two rows. The third question allowed the respondent to check a box and skip to the next section.

### 5. Possible Data Analyses

Many of the messages we discovered from respondents made us wonder if there were even larger issues beneath the surface. They gave us ideas for things to study further that we might not have thought of otherwise. When we identified possible data quality issues, we tried to come up with some sort of data analysis where we could determine how widespread the issue is in the greater population, whether it really was affecting data quality. For example, when we see that certain items were more likely to have ranges reported, we want to look at the respondents' data to see the extent to which rounded numbers were reported for these items. Such rounding would also indicate likely estimation.

Another analysis we want to see is the number of respondents who entered zeroes for the two percentages that should total 100 percent. These respondents' data should be recoded

as missing responses. In addition, we also want to know how many of these respondents answered a zero for the question referenced. That is, they cannot calculate a percentage of zero.

**Worldwide R&D performed by your company**

**4-1** What were your company's total worldwide costs in 2008 for R&D that was funded or paid for by others not owned by your company?

*No outside funding*

\$Bil.	Mill.	Thou.
		0

*n/a*

**4-2** How much of the 2008 worldwide costs reported in Question 4-1 for R&D that was funded or paid for by others not owned by your company was for R&D performed by your company and how much was for R&D performed by others not owned by your company, such as subcontractors or subgrantees?

a. R&D performed by your company .....

\$Bil.	Mill.	Thou.
		0

**Include:**

- All costs for R&D performed by your company's full-time, part-time, and temporary employees

b. R&D performed by others not owned by your company, such as subcontractors or subgrantees .....

\$Bil.	Mill.	Thou.

c. Total (equals Question 4-1) .....

\$Bil.	Mill.	Thou.

**4-3** Was the amount entered in Question 4-2, line a, greater than zero?

Yes → Continue with Question 4-4

No → Skip to Section 5

**Figure 11:** Respondent's Message Showing the Effort Made to Answer the Question

Data analysis could also shed light on the data quality of the yes/no series. We want to know how many of the respondents answering "no" to all the items about new agreements are also answering a zero for the number of new agreements. Again, the data should be recoded to missing information since the question really does not apply.

One might say that such data analyses could also be constructed from a common sense approach. If referenced questions are not answered, we would want to recode the data as missing. In response, we argue that many things make sense in retrospect. The messages from respondents gave us a new perspective to see these issues more clearly. We find a parallel in testing questions. A respondent will point out something that is clearly a problem, but we never saw the problem until we looked through the eyes of a respondent.

## 6. Solutions for the Business R&D and Innovation Survey

For this population, we see that some respondents feel a need to provide an answer for every question. One solution might be to provide boxes for respondents to check that indicate that a page or a question is skipped when it doesn't apply. For example, the series of questions on R&D agreements might be handled by a solution such as a checkbox with instructions.

**If you do not have any R&D agreements, please  
check this box and skip to Question 3.17**

Another reason for providing a way for respondents to address every question might relate to a common strategy for completing the survey. Many respondents have told us in interviews that they use the paper version of the questionnaire as a worksheet. Then, they provide the survey responses via the web survey application. For these respondents, it would be helpful to have something on every page, if not every question, to note to themselves whether or not they need to key a survey response for the web survey.

Another solution inspired by our study results is to offer a way for a respondent to indicate that an answer is estimated. For example, underneath the answer box, we could offer a way to indicate whether the response is exact (“book value” to accountants) or an estimate.

Example:

Please mark the type of answer you provided

\$\_\_\_\_\_

- Book value
- Estimate

Survey managers are wary, however, of providing an “easy way out” for respondents. Would respondents actually go to the trouble of looking up a book value when an “estimate” seems to be acceptable? For our survey population, the respondent is usually wary of providing an estimate. Accountants like to provide exact figures. An experiment might tease out whether offering the option would result in more or less rounded answers.

## 7. Conclusions

Respondent messages can point to data quality issues. We learned that some items were estimates. Other items were completed, but the ranges respondents gave showed the respondent's lack of a definitive answer. On the web, respondents are forced to enter a specific number, when they may not feel that confident in one number, but would prefer a range. Similarly, on the web, there is usually no way to mark numbers as estimates. One possible solution would be to offer comment boxes on each web page to encourage more messages from respondents.

Respondent messages might also highlight issues with data entry concerns. If the respondent wrote a zero on a line drawn across a series of items, did the data entry staff actually enter zeroes for each item?

Respondent messages can point to flaws in the design of the questionnaire. Missing skip patterns caused a cascade of messages. The language of some of these messages indicates that respondents may be frustrated when they are asked to answer questions that do not apply based on earlier answers.

Messages from respondents provide new perspectives to generate additional ideas for data analyses. Seeing things through the respondents' eyes highlights issues that seem obvious in retrospect. We might have missed these issues without hearing respondents' side of the conversations.

In summary, if mail surveys make a comeback as part of a mixed mode strategy, we may once again see respondent messages on forms mailed back to us. By coding these respondent messages, we can target areas that address data quality.

## 8. References

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