

# Developments in Electronic Survey Design for Establishment Surveys

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Key words: electronic form design, usability testing, establishment surveys, web surveys

## Abstract

As electronic-based surveys grow in popularity, many agencies have developed their own sets of electronic form design practices. Some of these practices developed from research while other practices developed from field-based experience. This paper acts to synthesize a variety of electronic form design practices used by the establishment surveys at the U.S. Census Bureau. These practices are based on research and findings from cognitive and usability testing. Because these findings evolved out of respondent testing, the Census Bureau has been able to develop electronic survey design features for establishment surveys that integrate well with the activities and tasks respondents perform to complete surveys. This provides for a more respondent-centered electronic survey design. In this paper, we discuss topics such as working with internal Information Technology staff, addressing the visual differences between paper and electronic forms, respondents use of paper associated with electronic response, and the use of real-time edits and other electronic-only features. The paper will also discuss the potential implications of the Census Bureau's findings for both household and establishment-based surveys, and outline areas that need more research.

## 1.0 Introduction

As concerns for establishment survey nonresponse rates increase, survey managers have investigated alternative ways to encourage survey participation. One alternative is to offer multiple response modes including mail, fax, and electronic data collection. Electronic data collection includes both downloadable and Web computerized self-administered questionnaires (CSAQ). Downloadable CSAQs are executable files that are either mailed to the respondent on a disk or CD or are downloaded from a Web site onto the respondent's computer. Respondents enter their data directly into the application, which stores the data on their computers until they submit the information to the survey agency. Web CSAQs, on the other hand, exist on a secure Web site that respondents log into in order to enter their data. The data are then stored on the survey agency's computer servers.

As electronic data collection has grown in popularity, the U.S. Census Bureau has developed both a Web and downloadable CSAQ application. In the Economic Directorate the Web CSAQ is primarily used by company-based surveys, while the downloadable CSAQ is primarily used by establishment-based surveys, including the economic census. Since many establishment surveys use either the Web or the downloadable CSAQ application, the Economic Directorate has developed a set of specific design practices for both. This paper acts to synthesize the variety of electronic form design practices used by establishment surveys at the Census Bureau and to provide an understanding as to why these practices were developed. This paper will conclude with a discussion of the implications of these practices for both household and establishment-based surveys and outlines areas that need more research.

## 2.0 Background

In addition to maintaining and improving response rates, survey managers undertake electronic data collection methods for two main reasons: to improve data quality and to decrease cost. Both downloadable and Web CSAQs affect data quality and cost, however, in a different manner than a paper form. First, electronic methods can improve data quality by providing additional help screens and other visual or

audible media applications that can help to simplify the response task. A poorly designed electronic form, however, may not only complicate the response task, but may also cause a respondent to abandon the mode or the survey altogether. An additional challenge programmers face is that each computer and Internet browser has a different array of settings that forces them to take into consideration several design possibilities. Another challenge for downloadable CSAQs is that some respondents are required to get special permission or involve the company's Information Technology staff before they can download an application. This process can add additional time and burden that may affect the respondent's mode decision and the timeliness of survey completion.

Next, electronic methods can reduce cost by limiting the amount of data entry and response follow-up needed by a survey. For paper forms, respondents write their responses on the form, submit the form to the data collection agency, and an individual at the agency enters the responses into a database. By using an electronic form, the respondent is entering the data directly into the database, thus eliminating the need for additional staff to enter the data for the respondent. Equally, data edits internal to the electronic system help to reduce missing or questionable data, which in turn reduces the number of follow-up calls and data review conducted by a survey office. While the lack of both data entry and response follow-up help to reduce cost, there are some additional costs associated with electronic data collection. Electronic data collection methods, unlike paper forms, require more up front costs to create a system and maintenance costs to maintain the system throughout its use. Offering multiple modes can also complicate data integration between the different modes, survey operations, and data analysis, all of which can increase cost. (Cohen et al, 2006; Rosen, 2007)

## 2.1 Types of instrument testing

Currently, the Census Bureau conducts two main types of instrument testing with respondents: cognitive testing and usability testing. Both testing types have the ultimate goal of building a form that will increase response rates and data quality while reducing respondent burden. Cognitive testing focuses on the cognitive process used by a respondent to answer questions, including question wording and context. Usability testing focuses on the interaction of the response process with the electronic reporting application, including form navigation, visual formatting, and various electronic reporting functionalities. Testing results are then used to identify common patterns across all test subjects, which are then used to make informed design decisions. The main limitation to the testing is that it is qualitative in nature. Thus, the results cannot be inferred to the population, however, more quantitative research is often too time and cost prohibitive.

At the Census Bureau, both types of instrument testing are conducted by cognitive or usability experts at business respondents' locations, using either the respondents' computers or a Census Bureau laptop. Both types involve a protocol and usually include both a cognitive/ usability expert and a subject area expert. The protocol usually includes three sections: one that gathers general information about the respondent and the business, one that gathers detailed information about the questions or the application and one that gathers overall feedback on either the questions or the applications. (Anderson, 2003) The protocol usually incorporates different testing techniques including think aloud questioning, probes, task based scenarios and application prototypes.

## 2.2 Establishment surveys

Much of the research that currently exists in the survey field focuses on household surveys. While there are many similarities between household and establishment surveys, there are also several differences.

Unlike many non-Government household surveys, establishment surveys rarely ask opinion or attitude questions and instead focus primarily on factual questions with definite answers. In general, factual questions tend to include technical concepts with precise definitions and tend to require record based retrieval, both of which may increase respondent burden. Also, unlike household surveys in general, establishments often require higher-level authorization before completing and submitting a survey to the Census Bureau. (Morrison, et al 2002). Many establishment surveys at the Census Bureau are panel surveys with units remaining in the sample for several years; if the unit is sampled with certainty and then it is

always in the sample. Respondent burden also differs for establishment surveys because they often require multiple respondents across multiple sessions to complete one survey form.

The Census Bureau has conducted research focusing on the use of both downloadable and Web CSAQ survey electronic forms. This research, coupled with the results of extensive cognitive and usability testing, helped to shape the practices outlined in this paper.

### **3.0 Design Practices**

The following design practices have been divided into two categories: those that effect form design and those that effect data collection. The practices included in the form design section focus on the layout of the electronic form while the practices in the data collection section focus on the information collected by the electronic form.

#### **3.1 Form Design**

##### Design Practice #1: Instructions and Text

Establishment surveys tend to have a significant amount of text accompanying the questions.

Standard question writing principles, such as keeping a question short and only asking one concept per question, apply to both paper and electronic modes. Both Dillman (2000) and Sudman et al, (1982) provide standard guides to question writing and formatting. Paper and electronic modes, however, have different ways of presenting text in a useable manner.

At the Census Bureau, we have tested two main ways to increase the readability of an electronic form. One way is to use visual cues to call attention to important information. Visual cues include items like arrows or bold typeface. Another way is to use help buttons and hyperlinks to remove text from the main page and place it on a secondary page with a link from the main page. This helps to eliminate text from the main page, but still makes it accessible to the respondent. Whether or not to use visual cues or help buttons and hyperlinks depends on the importance of the information. If the information appears with the question on paper, then it is presented with the question on the electronic form. If the information is in an instruction booklet or some other supplemental materials, a help button or hyperlink is the best place to present the information to the respondent.

##### Design Practice #2: Pre-filled Information

Some establishment surveys include pre-filled items that survey managers do not want respondents to change such as unit name and address, industry identifying codes, or other identifying information.

While there is no research on pre-filled items in either paper or electronic forms, Census Bureau researchers have observed how respondents react to incorrect pre-filled items in the test setting. On paper forms, respondents often make corrections to pre-filled items by crossing out the incorrect information and writing new information directly on the paper form. On electronic forms, however, respondents are often left with no way to correct incorrectly pre-filled items. This often frustrates respondents because it forces them to submit incorrect information.

Currently the Census Bureau uses two methods to allow respondents to correct pre-filled items. One method is to allow respondent to correct the pre-filled item directly in the pre-filled response boxes and handle the corrections in post –collection processing. The other method does not allow respondents to change the pre-filled item; instead either a second set of response boxes or a remarks box is provided. This way a respondent is able to update and submit correct information without changing the needed information to identify each unit for processing purposes. Either response or remarks boxes must appear on the same page as the original information. From a respondent's perspective, we recommend the former, however, due to processing limitations the latter maybe necessary.

### Design Practice #3: Tables

Many establishment surveys collect data using table or matrices.

Tables and matrices must be carefully designed to maximize usability while collecting the necessary survey data. This task is complicated for electronic form design because people have a harder time comprehending tables on a computer screen versus a paper form. It is further complicated for Web forms where the respondent's browser and computer settings may affect the ultimate table appearance.

Through testing we have found that horizontal and vertical scrolling increases respondent burden by making the table more difficult to navigate. As programming languages have become more sophisticated, programmers are able, in most cases, to ensure that a page does not scroll horizontally unless the screen is minimized to a smaller size. However, depending on the programming language used, there may be other issues with justification, indenting, and numbering. Vertical scrolling should also be minimized by breaking up large tables from the paper form into multiple tables of similar items on the electronic form. All table elements, including scrolling, should be tested across several platforms in order to ensure optimal table design.

### Design Practice #4: Edits

A major benefit of electronic forms is the ability to use edits to check for erroneous data prior to submission.

Anderson, et. al (2004) showed that well-designed edits can reduce cost by reducing data follow-up and increase data quality while maintaining respondent cooperation. They found that increasing the number of edits did not necessarily increase unit nonresponse and/or survey abandonment rates. They also suggest allowing respondents to override edits, submitting data with unresolved edit failures, and reminding respondents of remaining unresolved edit failures will help to reduce response burden associated with edits.

The Census Bureau testing has found that effective edits are ones that provide clear explanation of both the error and, if applicable, its possible solutions. This is especially important when a survey uses complex edits based on ratios or other calculation. When using these edits it is important that the respondent not only understands what number(s) is incorrect but also what calculations occurred so the edit is transparent to the respondent. Testing has also shown that the edit messages should be located near the edit-failing data in order to aid the respondent's comprehension. Overall, survey managers should only use edits for the most important data items as too many edits or poorly designed edits can increase response burden and can complicate post-data collection processing.

### Design Practice #5: Remarks Box

A standard feature of most Census Bureau paper surveys is a remarks box at the end of each form.

Remarks boxes provide respondents with space to clarify their data prior to submission. On a paper form this space is usually the last item because navigation between individual items and the remarks box is as simple as turning between pages. On an electronic form, testing shows that respondents need remarks boxes on any page where they may need to include additional information. This is because navigation within an electronic form is potentially more difficult and respondents are less likely to move to the end of the form to enter a remark.

## 3.2 Data Collection

### Design Practice #6: Electronic Form Uptake

Survey managers often view electronic forms as a solution to survey nonresponse only to be disappointed by low uptake for the new mode.

Hak et. al (2003b) studied the factors that influence a respondent's decision to complete a paper or electronic form in multiple mode surveys. They found that respondents base their mode selection decision on subjective reasons rather than objective reasons. Subjective reasons varied from reduced chance of their form getting lost during submission to electronic forms being better aligned with company priorities to go

paper-less. Objective reasons include number of pages or stated burden hours. Hak et. al also found that actively contacting respondents to convert to electronic reporting either via the telephone or personal visits, improved the likelihood they would of respondents adopt the electronic mode. They found that once a respondent switched to electronic forms, they rarely reverted back to paper forms. Census Bureau testing confirms these findings.

Census Bureau usability testing has found that respondents are often unaware that an electronic option is available for a survey. While the most effective method is active recruiting, making the electronic option more visible to respondents is often necessary. Some possible methods include mentioning the electronic option directly on the paper form or on a separate postcard or letter mailed with the advance letter or in separate but closely timed mailing. Marketing the electronic option may be more effective if it focuses more on subjective reasons rather than objective reasons for respondent uptake.

#### Design Practice #7: Navigation

The navigation of an electronic form is important regardless of the survey type, but it is especially important for establishment surveys.

Testing found that the Census Bureau's electronic forms often violated the respondent's expectation of how the form should appear and how it should function. Often respondents stated that they want a form to operate like other familiar web forms or applications. When the electronic form fails to meet their expectations, some respondents may abandon the survey while other may struggle thought it. Navigation is also complicated because establishment surveys are often completed in multiple sessions, using multiple respondents and multiple data sources.

First, because respondents often complete the electronic form in multiple sessions and in a non-sequential manner, navigation within the electronic form must be clear. This includes clear navigation from the login page to the last completed item, clearly labeled navigation buttons and drop down menus, and unique page headers that the respondents can use as page identifiers. Another navigation issue involves the use of skip patterns within electronic forms. Skip patterns should be applied carefully as overuse or complex skip patterns may make skipping around within the electronic form difficult.

#### Design Practice #8: Entering and Exiting

The login, submission, and save function of an electronic form must be transparent to both respondents and survey agencies.

Logging into an electronic form requires a balance between security and ease of access. Often respondents realize that the complex login feature is necessary to protect their data. However, because the paper form is still a secure reporting method, respondents may abandon the electronic form if login is too difficult. Until a secure but simple login function is developed and accepted, survey organizations should develop a straightforward page that clearly provides directions on how to login to the form and how to get help if they have difficulty logging in.

When a respondent completes a paper form, they sign the form certifying the reported data is correct, and then they either mail or fax the form back to the survey agency. This process demonstrates to both the respondent and the survey agency that the respondent is finished with the form and that the agency can begin to process the data. Downloadable CSAQs and paper submission are similar because in both instances the data resides on the respondent's computer and an action must be taken to definitively submit to the agency. Web CSAQ submission, however, differs because the data resides on the agency's servers and the submission process is not as apparent.

At the end of a Web CSAQ, the respondent is presented with a certification page that is similar to the paper form sans the physical signature. Next, respondents are asked to review any outstanding data edits and select whether they are, in Web CSAQ terms, "finished" or "finished with problems" before submitting the form to the Census Bureau. The respondent is then presented with a completion certification, which appears on the same page as the main menu.

In testing, we have found that respondents need clear submission instructions and reinforcement that they have certified and submitted their final form. This is challenging in electronic forms because a respondent cannot physically sign the form and are often confused by the submission process. First, respondents are able to submit a form with unresolved edit failures, which some respondents view as an incomplete submission even though they may have legitimate reasons for submitting edit-failed data. Next, we have found that respondents associate the word “submit” with submitting a completed form and not other terms like “finish.” Finally, testing has shown that many respondents expect the completion certificate to appear on its own page with a clear print feature, as they often need a copy of the certification for their records.

Saving data is another important feature of an electronic form. Because respondents often compete survey forms in multiple sessions, requiring them to “quit” and reenter, it is necessary that their data be saved in a transparent manner. It is also necessary for the reentered form to be repopulated with the saved data.

#### Design Practice #9: Use of Paper Forms

Establishment survey respondents often use the paper form in conjunction with the electronic form.

Both Hak et. al (2003) and Census Bureau testing showed that respondents who opt to report electronically often use the paper form in conjunction with the electronic form. First, respondents sometimes find it is easier to use paper to collect information from multiple people or multiple source documents. Another reason is that people are often unsure if the electronic form will allow multiple sessions and prefer to enter the data all in one session. Finally, most economic survey respondents are required to keep a copy of their completed form for the company records and many still prefer a paper to an electronic copy.

To help respondents complete the electronic form while cutting back on cost, it is important that respondents can easily access an electronic copy of the paper form. A link to the form can be located directly on the front page or main menu of the form’s Web site or on a separate survey home page. At the end of the survey, it is important to provide the respondent with a paper and/or electronic copy of the form for their records. In testing, we have found that most respondents prefer a .PDF file that is populated with their answers and is visually similar to the paper form. It can also be a list of questions and their answers.

Ultimately, electronic form design, just like paper form design, is challenging and there is only one universal rule regardless of the target population: Be consistent. This is why good research and testing should play an important role in the lifecycle of a survey.

### **4.0 Discussion**

This paper has outlined nine Census Bureau electronic form design practices for economic surveys. These practices are based on research and findings from both cognitive and usability testing in establishment surveys. Good design practices, however, are only one part of the development equation. Electronic form development also includes understanding the impact of design practices on survey uptake and the use of an effective development strategy to integrate the desired design practices into the final application. The following discussion focuses the interconnection of these three aspects of electronic forms design: design practices, survey uptake, and development strategy and consider their implication for both household and establishment-based surveys and outlines areas that need further research.

#### **4.1 Electronic Form Uptake**

A well-designed and well-tested electronic form is only worth the time and monetary investment if respondents use the data collection mode. Groves et. al (2000) explain a respondent’s survey decision process using the framework of leverage and saliency. Leverage suggests that any survey attribute, for example survey topic or incentive, holds a certain amount of leverage or importance for any sample person. Saliency suggests that the activation of the leverage depends on whether the survey attribute is made salient to the sample person by the survey organization. Groves et. al show that not only is it important to understand what concepts or features increase a person’s response propensity but also that it is important to present them in a manner that is noticeable by the respondent.

Currently, there is little research on electronic form uptake and the factors that affect a respondent's decision to use an electronic form over another reporting method. Hak et. al (2003a) found that in an establishment survey, a person's propensity to use the electronic mode was not based on objective concerns like burden hours or page length, but subjective concerns, like the ability to complete the form without leaving their desk. Hak et. al also found that perceived reward plays a significant role in a respondent's decision to convert to electronic reporting, noting that respondents will take on large amounts of burden if the perceived reward is great enough. Thus, although respondents recognize that some features of an electronic instrument may be more burdensome, like login procedures or edits, they are willing to convert if perceived benefits accrue, such as becoming a paperless office or gaining confidence in the correctness of their reporting.

Similarly, Dowling and Stettler (2007) found that in national establishment surveys, a person's response propensity is based on their perception of Web forms as global progress, the Web as a more efficient means of data collection, and specific design features that simplify the response process. They note that while statistical organizations have little influence over the first two factors, the third factor is entirely in their control and that it is vitally important that they get the functionality right. They show that design features are important to respondents and that respondents carry specific expectation into Web form completion. If Web forms fail to met these expectations, a respondent may abandon the form, unless the perceived benefits outweigh counter-intuitive design features.

#### 4.2 Electronic Form Development

Because electronic design features are important to respondents, influencing their uptake decisions, it is important that they receive prominent attention during instrument development. Electronic form design requires cooperation between subject area, usability, and information technology experts, each with their own set of design priorities. For subject area experts the priorities include minimizing processing cost while maintaining data quality and comparability. For usability experts the priority is the respondent's perspective and form use, while IT experts focus on the actual layout, form design, and functionality. Understanding each group's priorities and working together to design the optimal electronic form is often a challenging task. This is often complicated by survey agencies' development approaches and their management structure.

Fox et al, (2003) describe two main design approaches used by survey agencies to develop electronic forms: the waterfall lifecycle model and the user-centric model. The waterfall model is a design approach where one step follows after another step with little feedback back to the previous step. Respondent feedback via usability testing is only one step in the process and usually occurs just before final application dissemination. This model, while used by many large survey projects, is a relatively inefficient design method that can allow unresolved usability issues to remain in the final application while increasing processing and programming costs. A user-centric model, however, requires both iterative design that incorporates the respondent's perspective at multiple points in the development process, and integrated design that simultaneously coordinates work across all design components. In this way respondents' expectations for specific design elements are integrated early in the development process. This model helps to reduce cost and programming time as issues are resolved early in the process and fewer usability issues are likely to remain in the final application. This model is not only more efficient but also incorporates usability findings throughout the development process, helping to reduce later cost and frustration.

Another component of electronic form design is the decision to have a single agency wide Web application. Levi et. al, (2002) found that the Bureau of Labor Statistic's decision to centralize its electronic reporting infrastructure while distributing instrument development to the survey offices was a good decision but not cost-free. They found that sharing a common infrastructure reduced the burden on each program office; however, each program office would likely be shortchanged by the inability of the infrastructure to meet the structural needs of their surveys. As a result, respondents' expectations may not be met. Moreover, the main cost was not the decision itself, but rather trying to make disparate areas work together to create one corporate application. This process was further complicated because information technology programmers are often independent of the program office and answer directly to someone other than the survey manager. In some instances, programmers may be outside of the traditional management hierarchy altogether. They

may not be compelled to program feature that meet respondents' expectations, even when they are included in the specifications.

#### 4.3 Future research

As electronic-based surveys continue to grow in popularity, survey organizations must further understand the effects of design decisions not only on cost, but also on data quality. One of the continuing challenges facing survey researchers is how to define and measure data quality. And how do survey managers know if the electronic form is actually making their survey data better?

In addition, most establishment surveys use an electronic form as only one of several modes for collecting data, thus raising the further question of data consistency. Data consistency does not mean that the survey forms should look identical, but rather that the information collected by each mode is the same regardless of which mode the respondent uses. While both paper and electronic forms are self-administered forms with a visual question presentation, careful consideration should be used when designing and implementing both modes together. While research on data consistency with electronic forms is limited, cognitive and usability testing have shown that respondents interact with paper differently than a computer screen and these differences need to be taken into account when designing both modes. (See Dillman et al., in press, for further discussion.)

Ultimately, the study and application of good survey design practice is key. This is especially important, as survey organizations continue to use multiple mode surveys with electronic reporting options to collect survey data. This also makes research on data quality from electronic reporting and its uptake imperative, especially as the focus on nonresponse error increases.

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