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Achieving Data Quality in a Statistical Agency: A Methodological Perspective

RECENT DEVELOPMENTS IN ELECTRONIC DATA COLLECTION AT THE U. S. CENSUS BUREAU

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ABSTRACT

Since 1996 the Census Bureau has been creating Web Computerized Self-Administered Questionnaires (CSAQs). These electronic questionnaires have data quality advantages over paper by the use of interactive edits, which allow respondents to correct their responses as they are entered, on-line help, pre-loaded data, and for establishment surveys, importing of data from spreadsheets. This paper will provide an overview of the Census Bureau's Web CSAQs. Each of the Web CSAQ design features that promote data quality will be explained, as well as the features that impose obstacles to quality. Finally, some recent empirical data quality results from both establishment and household surveys will be presented.

KEY WORDS: CSAQ; Internet; Web; Quality; Response.

1. INTRODUCTION

1.1 Birth of Web CSAQ

The U. S. Census Bureau began to use Computer-Assisted Survey Information Collection (CASIC) tools in the early 1980's. The first uses were Computer-Assisted Telephone Interviewing (CATI) with Computer-Assisted Personal Interviewing (CAPI) following several years later. These technologies were mostly used for household surveys, which were traditionally conducted by interviewers. However, establishment surveys did use CATI, minimally, to perform their non-response telephone follow-up. To take greater advantage of the benefits of computer automation, the use of CASIC technologies for self-administered establishment surveys needed further exploration. It was unlikely that establishment surveys would convert to an interviewer mode from a mail out/mail back self-administered mode of data collection. Therefore, a new self-administered CASIC technology needed to be developed and implemented within the Census Bureau.

In 1992 the Census Bureau began to research the Computerized Self-Administered Questionnaire (CSAQ) technology. The first CSAQ was an electronic questionnaire containing all of the automated survey questionnaire functionality of a CATI or CAPI instrument. However, this electronic questionnaire was copied to a diskette and mailed to the respondent, who in turn loaded it on their personal computer (PC), completed the questionnaire, and sent the response data to the Census Bureau on the diskette or by computer modem.

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Sweet and Ramos (1995) and Ramos and Sweet (1995) report some favorable results of this diskette CSAQ research.

With the success of this diskette CSAQ testing and the rapid growth of the Worldwide Web in the mid-1990's, the next logical CASIC technology to test became the Web CSAQ. This again is an electronic questionnaire containing all of the automated survey questionnaire functionality of the diskette CSAQ but the method of distribution to and from the respondent is by the Web instead of by mailed diskette.

1.2 Benefits of Web CSAQ

When the diskette CSAQ was first proposed, several benefits were anticipated. These included better quality data, reduced respondent burden, quicker survey timing, and cost savings to the Census Bureau. Better quality data results from built-in edits which prompt the respondent to resolve keying errors as they are made or explain data anomalies while reporting. Automatic data fills and calculations, automatic skipping of not applicable questions, and a reduction of future telephone calls to the respondent to resolve data anomalies reduce the respondent's reporting burden. These respondent burden reduction features help the respondent to report faster and the elimination of data keying and verification and the decrease in error resolution telephone calls at the Census Bureau reduce the time needed to prepare the survey data for publication. And finally, the cost to conduct a survey should decrease since the use of diskette CSAQ would decrease form printing and storage, package preparation, postal charges, telephone calls by survey analysts, data keying, and keying verification.

With the use of Web CSAQ all of the same benefits mentioned for diskette CSAQ were also expected. Additionally, the costs benefits would be even larger since diskettes would not need to be prepared, packaged, and mailed. Timing would be better because data transfer on the Web can be done in seconds as opposed to days through the postal system. With such a large array of benefits, pilot testing of the Web CSAQ technology proceeded in full force.

1.3 Disadvantages of Web CSAQ

Even though there is a potential cost savings brought about by Web CSAQs, there are costs associated with the development that outweigh those savings. Since Web access is not universal, surveys using Web CSAQ must be multi-modal, thereby increasing the expense of survey data collection. These expenses include acquiring staff, contractors, hardware, and software, training staff, testing and debugging software, and establishing a Web CSAQ help desk. Additionally, various browsers display and handle electronic forms differently. Special programming is required to overcome these variations again adding to the cost of the survey. However, as the Web CSAQ technology becomes more established and routinized, these costs should decrease.

This paper provides an updated report of Web CSAQ research by the Census Bureau and how it relates to data quality. It lists briefly the goals and results of all of the Census Bureau's Web CSAQ research. Sedivi, Nichols, and Kanarek (2000) describe in more detail the early Web CSAQ pilot tests. This paper will also discuss the various design features of Web CSAQ that are thought to improve on the survey data quality and characteristics that may actually be obstacles to data quality. Finally, test design and results from the American Community Survey (ACS), Annual Survey of Manufacturers Supplement Survey of Computer Network Use (E-Commerce), and Methods Panel Web Survey (MPWeb) Web CSAQs will be described.

2. BACKGROUND

2.1 Computer Assisted Survey Research Office

In 1992 the Computer Assisted Survey Research Office (CASRO) was formed at the Census Bureau. The mission of this office is to implement CASIC methods in Census Bureau data collection and processing in an expeditious, coordinated, and cost-effective manner. To do this, CASRO is to test available technologies as soon as possible in appropriate and coordinated ways so that informed decisions, related to inclusion of each technology in the CASIC program, can be made. Once CASIC activities are tested and approved CASRO makes policy recommendations on funding, the location of CASIC equipment and staff, and organization restructuring to facilitate this new technology.

2.2 Web CSAQ Testing

Since 1996 CASRO has developed and implemented Web CSAQs for 13 surveys. The majority of these have been for establishment surveys but two were household surveys. The first few, 1996 Survey of Industrial Research and Development (R&D), 1998 Company Organization Survey (COS), and 1998 field test and 1999 production Library Media Center Survey (LMC), were performed purely as a test to see if we could successfully create a Web CSAQ containing all of the desired functionality and the required data security and especially to see if the respondents would use the Web CSAQ to report. As mentioned by Nichols and Sedivi (1998) and Zukerberg, Nichols, and Tedesco (1999), results of the R&D and LMC Web CSAQs were promising since the respondents were willing and able to use these Web CSAQs. Also, both the diskette CSAQ and Web CSAQ respondents for the 1998 COS were asked a series of evaluation questions. One such question was if they would use the Internet to complete the 1999 COS. Seventy-one percent of both the diskette and Web CSAQ total respondents indicated that they wanted to use the Web CSAQ next time (Sedivi and Nichols, 1999). Consequently, a Web CSAQ for the COS has been conducted every year since then and the number of Web CSAQ COS respondents has increased to over half of the total survey establishments. Additional testing of other surveys has continued.

With this earlier testing, we had already proven the feasibility of creating Web CSAQs that respondents would use. Now we still had some additional questions about Web CSAQ that needed to be answered. First, was there a better way to provide data security? In May 2000, we implemented a Web CSAQ for the Manufacturers' Shipments, Inventories, and Orders Survey (M3) using digital certificates. We planned to use the digital certificates for authentication and encrypted email. The certificates worked reasonably well for authentication, but we decided not to implement certificates for encrypted email due to software compatibility issues and ease of use considerations. Our research showed that most respondents are not yet familiar with using digital certificates. An example is that most respondents did not save or export their certificates and we periodically needed to replace certificates when they received a new computer. We found that digital certificates added both cost and an administrative burden.

Also in 2000, we created a Web CSAQ for the 2000 Annual Survey of Manufacturers Supplement Survey of Computer Network Use (E-Commerce). The Web CSAQ for the E-Commerce survey was offered to 48,000 respondents. This was larger than any other Web CSAQ survey that we had conducted up to that point. The purpose of this test was to see if our Web CSAQ system was scalable enough to handle a survey of that size. The loading of the cases into our database proved to be quite slow but the system eventually handled the survey well. The next test was with the Quarterly Financial Report (QFR) in the fall of 2000. This survey provided a slight twist in the implementation of the Web CSAQ. Here the respondents received the electronic questionnaire as a diskette CSAQ. Once completed they were able to connect to our Web site and upload their response data. The test respondents found this useful and this diskette/Web CSAQ is being offered now to about six percent of the entire QFR panel.

Up to this point, all of the tests were on establishment surveys. At the end of 2000, we conducted a household survey, the American Community Survey (ACS), with a Web CSAQ option. At the beginning of 2001, we selected a sample from the Methods Panel Survey of Income and Program Participation (MPSIPP). This sample became the MPWeb panel which was used to specifically test the feasibility of collecting demographic survey data on the Web. Another added benefit of the MPWeb test was that we had a chance to test a new authoring package, Macromedia Flash version 4. Our next Web CSAQ request came from a survey sponsor, Bureau of Justice Statistics (BJS). They requested a Web CSAQ for their National Prisoner Statistics Survey (NPS) for release in early 2001. One requirement presented by BJS was that the NPS Web CSAQ must be accessible by the disabled. To do this, we had to implement a variation of our method of presenting on-line edits. Finally, as more people within and outside the Census Bureau heard of our Web CSAQ system, we had many more requests to develop Web CSAQs. At this point, most Web CSAQ projects were becoming a routine production of similar Web CSAQs performed on a tested and proven system. It was time to find a production home for Web CSAQ outside of CASRO's research environment.

3. DESIGN FOR QUALITY

3.1 Functionality

Many of the features that are intrinsic to all electronic questionnaires (CATI, CAPI, CSAQ, etc.) aid the respondent or the interviewer in providing quality data. Since respondents cannot be trained like interviewers, some additional aids need to be built into the CSAQs to help respondents even more. Also, when dealing with self-administered questionnaires, we have the concern about respondent reporting burden and frustration which brings yet another aspect to Web CSAQ design. With this perspective we have developed the following set of Web CSAQ features with the focus of improving data quality by the use of Web CSAQ.

- After entering the Uniform Resource Locator (URL), first the respondent sees a Welcome screen. To prevent break off from the survey at this point, we provide a help desk telephone number in case the respondent is having a problem or needs to ask a question before they proceed. To address respondents' concerns about security, we provide details about how we are securing their data as it is being sent over the Web. To help them through the log-in process, we provide information about how to enter their user name and password for authentication.

- As the respondents click on the "Enter the Survey" link/icon a check is performed to determine their operating system, browser and version, and whether or not they have JavaScript enabled. This check is transparent to the respondents. If a respondent is using a browser that does not fit within our mandated security requirements or has JavaScript disabled, a separate screen is displayed indicating the problem and containing a link to upgrade the browser.

- After the respondent has passed the browser check and cleared the user name and password authentication, the electronic questionnaire is presented. With a self-administered questionnaire, no interviewer is present to answer the respondent's questions and provide more details about the survey. Therefore, the Web CSAQ must have help information available to the respondent on-line. The help instructions need to be quick and easy to access, concise so the respondent's motivation to read the information does not wane, and available at the time the respondent needs the information. To address these needs, we have created several forms of help information. As the respondent first accesses the CSAQ, important general information in bullet format about the survey is presented on the screen before the first survey item. Additional information of less importance to the survey or information about how to use the CSAQ is provided in a pop-up window accessible from an icon at the beginning of the questionnaire. Other information which applies to only a few specific parts of the CSAQ is presented on the screen at the first point of usage. For example, the first time a radio button is used a description of radio button functionality is provided. Finally, specific details about

a particular question are shown in a pop-up window displayed upon clicking on a help icon beside the survey item. Definitions pop-up after clicking on a hyper-linked term.

- Presumably, the feature that improves data quality the most is the built-in edits. In all of the Census Bureau Web CSAQs, we have tried to perform the edits immediately at the point of entry by the use of client-side logic. When that is not possible as in the case of inter-item edits or item non-response, we perform the edits at the end of the form. We prefer to run these edits on the client's machine but recently to abide by the accessibility to the disabled mandate (Section 508 of the Rehabilitation Act) we have begun to run the end of form edits as well as a repeat of the within form edits on the Census Bureau's server. We then serve the error messages and CSAQ back up to the client's machine. In any case, whatever form of edits are used we try not to frustrate the respondent by forcing them to make a correction/entry or by influencing their response by an overly suggestive error message.

- For recurring surveys we mimic the paper questionnaire by displaying previous periods' reported data within the CSAQ. This aids the respondent in reporting the current period. Additionally, some of the edits perform comparisons between the previous and current periods' data. The respondent is able to correct the previous period data if need be. However, edits are not run on the previous period corrections.

- Like edits but more automatic, data fills and automatic calculations also make it easier for the respondent to provide accurate information for certain items.

- To guide the respondent to appropriate questions we use branching and skipping of non-applicable questions. Not only does this improve data quality but it also reduces respondent burden. Our Web CSAQs have two different forms of navigation, scroll-based and screen-based. The scroll-based is one long Web page through which the respondent navigates by scrolling. The screen-based is many pages with sequential navigation allowed by clicking on "Next" and "Previous" buttons at the bottom of the screen. Non-sequential navigation is performed by the use of a menu at the left side of the screen. For surveys that have a lot of branching or are longer than 80 items we have used the screen-based design. Hyper-links are embedded within the scroll-based to jump to the next applicable item. It is up to the respondent to use these since they are not automatic. Based on results from usability testing we believe that the hyper-links are underutilized by the respondent and have little effect on the data quality.

- For all of our Web CSAQs we have allowed the respondent to submit some of the data to our server, quit temporarily, resume access at a later time retrieving the partial data submission, and continue reporting. We also provide a separate icon which indicates that the respondent is finished reporting all items and is doing a final submission of data to our server. In our scroll-based CSAQs, prior to this final submission we give the respondent directions on "Steps to complete the Questionnaire". This reminds the respondent to print a copy of the questionnaire with their reported data. We also tell them to click on another icon called "Check your Work". This runs the end of form edits. If they click on the "Finished" icon before they check their work, the form pops-up a message reminding them to check their work.

- Some respondents are reluctant to report electronically if they do not have a copy of their report for their records. Therefore, we provide print functionality. They can print the CSAQ with or without their reported data. Some browsers caused printing problems for long, scrollable forms. For those surveys we have created a print friendly version that all browsers can handle.

- For companies with a large number of establishments on which to report, the use of importing reduces respondent burden. With importing the respondent is provided on-line guidelines on preparing a pre-defined spreadsheet containing their data. Once this spreadsheet is imported into the CSAQ, the edits

are run on the imported data, error messages displayed, and respondent corrections made. With this automatic entry of data into the CSAQ numerous transcription errors by the respondent are avoided.

3.2 Types of Web CSAQ

There are two types of Web CSAQ, on-line interactive and downloadable executable. The on-line interactive is displayed through the respondent's browser. It is easy and quick for the respondent to access. Most of the intelligence is performed on the client-side, but for disabled users, some intelligence must now be done on the server-side. The on-line interactive Web CSAQ is what most users expect when they use the Web. Unfortunately, the on-line interactive can not provide importing under the current system design. Therefore, we use the downloadable executable to provide this feature.

The downloadable executable has historically been used only for establishment surveys. Many of the respondents in establishment surveys are large companies with numerous establishments. To enter data for each of these establishments is a repetitive and tedious job. The importing capability allows the respondent to populate a pre-defined spreadsheet with each establishment's data. With the click of a button these data can be imported immediately into the CSAQ. This can not be easily implemented on an on-line interactive CSAQ. Additionally, if the large company were to use an on-line interactive CSAQ and they had to report in multiple sessions, then they would need to access the Web CSAQ and pre-loaded, historic data each time they resumed reporting. The long download time for their enormous amount of data would be repeated each time they logged in. Using an on-line interactive Web CSAQ in this situation would be prohibitive.

3.3 Testing

To verify the functionality listed above is understandable and usable by the respondent, we place our Web CSAQs through a series of testing prior to release to the respondent. The first that we do is called expert review. This is where we give a preliminary draft version of our Web CSAQ for review to an expert in cognitive psychology or human computer interface design. Comments are provided and corrections are made. A couple of rounds of this testing may occur. Next we conduct exploratory usability testing in the Census Bureau's fully equipped usability laboratory or we contract out with a usability contractor. Once comments and corrections are made from this, then we conduct confirmatory usability testing. This confirms that the previous recommendations have actually fixed the usability problem. In addition to these cognitive tests, we also performed a compatibility test on the American Community Survey Web CSAQ, which was programmed in XML/JAVA. This was especially important since this was our first time using JAVA and we were not sure if all browsers that the respondent would be likely to use would present the CSAQ correctly.

4. OBSTACLES TO QUALITY

4.1 Security

At the outset of Web data collection, security of the data was the biggest obstacle to overcome in the collection of quality data through the Web. During the early years of Web data collection, respondents were unfamiliar with the Web and they were afraid that their transmitted, proprietary data would not be secure. Nichols and Sedivi (1998) provide results from a screener questionnaire for the 1996 Industrial Research and Development Survey (R&D) Web CSAQ. This screener questionnaire was used to pre-screen respondents to be included in the 1996 R&D Web CSAQ experiment. These screener respondents were asked questions to determine their willingness and ability to report on a Web questionnaire. Of those screener respondents who had Web access, about 90 percent were willing to use it to report their R&D data. Only 57 of the 1,234 screener respondents were able to report via the Web, but unwilling to do so. Security concerns were the primary reason (39 percent) why these respondents were unwilling to report via the Web. Only two years later, during a Web CSAQ for the 1998 Company Organization Survey (COS), Sedivi and Nichols (1999) included evaluation

questions at the end of both the diskette and the Web COS CSAQ. One question asked if the respondent would want to use the Web to report next year. Approximately 71 percent of all the respondents (both Web and diskette panels) said they wanted to use the Web next time. At that time, lack of Web access was the primary reason why respondents did not want to use the Web CSAQ. Security concerns were another reason, but that was a motivating factor in only about 15 percent of the cases. So we see that the size of this obstacle is decreasing over time.

However, with that same 1998 COS Web CSAQ as well as the 1998/99 Library Media Center (LMC) Web CSAQ security did pose a different problem. This was related to the degree of security required. At that time it was mandated that 168-bit Triple Data Encryption Standard (DES) be used for Web data collection, thus making the Web CSAQ usable only by a respondent who had a U. S. only version of particular browsers. This requirement proved to be too stringent for most respondents and Sedivi, Nichols, and Kanarek (2000) show proof of this with response rates to these two Web CSAQs of 27 percent and 2 percent, respectively. In addition, another requirement for the security design of these surveys was that the user name and password be mailed via U. S. postal service to the respondents in two separate letters. This also was thought to be a factor in producing the low response rates since one letter may have gotten misplaced. Based on these results, security policy was changed for future Web CSAQs. Both 128-bit encryption and one letter containing both the user name and password have been used for all subsequent Web CSAQs (Kanarek and Sedivi, 2000). After that change, Web responses rates for these two surveys for the next year improved to 75 percent and 13 percent, respectively. Thus the less stringent security requirement improved the Web response rate and consequently increased the data quality.

4.2 Accessibility

Another obstacle that has recently surfaced is Section 508 of the Rehabilitation Act of 1973, as amended, 29 United States Code. Section 508 requires that when Federal agencies develop, procure, maintain, or use electronic and information technology, they shall ensure that the electronic and information technology allows persons with disabilities to have access to and use of information and data that is comparable to the access to and use of information and data by persons who are not individuals with disabilities, unless an undue burden would be imposed on the agency. This regulation specifically states that electronic forms shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form including all directions and cues. Inaccessible electronic forms may be used, if an alternative accessible electronic form with equivalent information, field elements, and functionality is also provided. This indicates that all electronic forms, including Web forms, must either be made accessible or an accessible alternative version of a Web electronic form must also be made available. It also states that not just the HTML (text of the form) must be accessible but also the logic and help created by the JavaScript or Java (functionality/directions/cues) must be accessible. However, it does not say to whom this alternative version must be made accessible. Perhaps it could be made accessible to the Web CSAQ help desk to read to a disabled person over the telephone. With this as a possibility, we have requested a waiver from this regulation. However, for some of the Web CSAQs that we conduct for outside sponsors, we have been required by those agencies to abide by the regulations imposed by Section 508. To do this we have moved all of the built-in client-side edits which would have required JavaScript, to the server-side. This has created added expense and effort as well as decreased the usability of our Web CSAQs by delaying the error message feedback. Client-side edits produce immediate feedback, while server-side edits can only be presented upon data submission. Currently, no Web tools are available which allow for auto-calculations or edits to occur in real-time without using Java, JavaScript, plug-ins or other non-compliant technologies. Hopefully, advancing technologies will catch up with this regulation soon.

5. DATA QUALITY RESULTS

5.1 Survey of Industrial Research and Development (R&D)

The first Census Bureau CSAQ was created for the 1994 R&D survey. At that time this CSAQ was distributed to and returned by the respondent on diskette instead of the Web. However, the other parts of the CSAQ, especially the quality producing features (edits, help, branching, skipping, auto-calculations, fills and pre-loaded data), were the same. Sweet and Ramos (1995) report that the reported data from the CSAQ panel had significantly fewer edit failures at headquarters than the data from the paper questionnaire control panel. This was proof to us that one of the expected benefits of CSAQ, improved data quality, was a reality. We were thus motivated to continue to develop additional CSAQs with the next being Web CSAQ.

5.2 American Community Survey (ACS)

A Web CSAQ was developed for the ACS using XML and JAVA as a test of offering respondents the opportunity to complete the survey via the Web. The primary objective of this test was to assess the impact of a Web reporting option on response rates. In addition, the test was used to compare the quality of Web versus mail responses. The Web ACS was not offered to the regular production samples. Instead, a completely separate sample (9,999) was selected and spread over three reporting periods, November 2000, December 2000, and January 2001 (3,333 addresses each month). The results from this Web experimental sample were compared to the results from the production mail only control sample. The only difference between the treatment of the Web experimental sample and the production control sample was that the Web experimental packages contained a letter inviting the respondent to report by using the Web CSAQ instead of the paper questionnaire.

Griffin, Fischer, and Morgan (2001) report the discouragingly low Web response rates for these three months of testing for the ACS. Between two and three percent of the experimental sample respondents chose to complete the survey over the Web. But even worse, the response rate for the Web experimental sample for both mail and Web responses was significantly lower than the mail response rate for the production control sample for all three months of the test. There was nearly a six percent lower overall (Web and paper) response rate for the Web experimental sample than for the production control sample.

One positive outcome of the ACS Web test was the cases completed through the Web were less likely to fail in a quality edit for completeness. Data from mail returned questionnaires and from Web returned questionnaires were run through the ACS automated edit system to obtain edit failure rates. Questionnaires submitted by the Web fared better in the automated edit than did those submitted by mail. There was a 21.92 percentage point difference in the edit failure rate of the production control sample over the Web responses from the Web experimental sample. This evidence supports our expectations that incorporating logic in the CSAQ as well as background information, general help information, and question-specific help screens reduce respondent error in completing the questionnaire.

5.3 Survey of Computer Network Use (E-Commerce)

Unfortunately, similar response rate results were obtained for the Survey of Computer Network Use a supplement to the 1999 Annual Survey of Manufactures (ASM) in a split mailing study. The ASM sample was split in half. In the first mailing, one half received both a paper questionnaire and a letter informing them that they had the option to report through the Web. The letter contained their user name and password and the URL for the Web CSAQ. The other half received only the Web letter. They were informed that within 30 days they would receive a paper questionnaire if they chose not to report by the Web. The second mailing for both panels reiterated the availability of the Web CSAQ. While the overall response rate was approximately 82 percent, there was a definite difference in the response rate for the two portions. The final response rate for the portion

that received the paper questionnaire along with the Web letter (84 percent) is roughly five percentage points higher than the final rate for the portion that received just the Web letter (Dodds, 2001).

Even with this second set back, the overall Web response rate of 24 percent promised to help us realize some of the benefits of Web CSAQ. Therefore, a similar study is being conducted currently for the Survey of Computer Network Use a supplement to the 2000 ASM. However, this time only the Web letter is being included in all of the first mail packages. A split panel study will not be conducted. Subsequent mail packages will contain the paper questionnaire as well.

5.4 Methods Panel Web (MPWeb) Research Project

In order to assess the feasibility of collecting demographic survey data on the Web, the MPWeb research project was initiated to explore Web reporting as a sole means of data collection for a household survey. The MPWeb sample was selected from people who responded to an existing demographic survey with a long and complex instrument. These respondents were pre-screened for Web access and willingness to participate in a Web questionnaire. In addition, only college graduates between the ages of 15 and 76 were eligible for the MPWeb survey. Since the MPWeb questionnaire contained numerous skips and branching, it was best to use the screen-based form of navigation. To do this we programmed the instrument by using Macromedia Flash for the first time. Debriefing questions were asked at the end of the Web questionnaire as well as on a paper questionnaire for non-respondents.

The MPWeb response rates like the other Web CSAQs mentioned above suffered. In early 2001, the 355 person sample yielded 79 completed on-line questionnaires for a response rate of 22 percent. As a sole means of reporting this is not acceptable. To provide this as an option along with paper reporting would add to the expense and effort of the survey data collection. However, the respondents who did complete the Web CSAQ rated the experience favorably in the debriefing questionnaire. The greatest concern of the respondents was the security of data transmission, followed by concerns about installing Macromedia Flash, if their browser did not already contain it. The greatest difficulty the respondents encountered was logging into the survey. Respondents who did not complete the Web CSAQ indicated that they did not have time as the main reason that they provided in their debriefing questionnaire (Griffin and Holbert, 2001).

6. NEXT STEPS

6.1 Transition to a Production Environment

This Web CSAQ system, which was originally established within CASRO for research purposes, has grown into a production system through which the Census Bureau implements Web CSAQs. Due to the growing demand of Web CSAQs, CASRO is no longer considered the appropriate location for handling the Bureau-wide need for Web CSAQs. Consequently, the creation of an expanded and institutionally supported Web CSAQ Production System (WCPS) is necessary to continue the effective development and implementation of Web CSAQs.

This transition to a WCPS is envisioned to include the creation or augmentation of staffs dedicated to Web CSAQ creation and management, as well as the construction of a secure and scalable computing infrastructure. Although the WCPS will draw from the expertise of various groups within the Census Bureau, the following staffs are proposed to make up the core working groups of the WCPS:

<u>Survey Management and Authoring Staffs</u> - There will be two staffs performing this function: one in the Economic Directorate and the other in the Demographic Directorate. These staffs will be charged with oversight of the entire WCPS process for their respective areas. They will create Web CSAQs, coordinate efforts between survey experts and the technologists needed to implement Web CSAQs, and provide overall

direction for planning and budgeting. In addition, these staffs will be responsible for funneling all requirements/procedures from various survey sponsors to the appropriate WCPS staff.

Applications Support Staff - This staff will work closely with the survey management and authoring staffs, and consist of technical personnel responsible for implementing Web CSAQ technology for the entire Census Bureau. This staff will include in-house programmers and network administrators sufficiently skilled in all aspects of Web technology. They will not author Web CSAQs, but manage the software used in the system. In addition, they will ensure that all security specifications and Web standards imposed by the Census Bureau or other federal laws are met.

System Support Staff - The WCPS will be a permanent sub-structure or extension of the Census Bureau's Intranet/Internet infrastructure. Management and support of the Web CSAQ hardware will be under the purview of the staff currently in charge of the Census Bureau's public and data dissemination Web infrastructure. They will perform overall Web CSAQ system administration functions.

Customer Service and Support Staff - This staff will be available to survey sponsors if they need assistance in providing help desk services to the Web CSAQ community. This resource will provide technical assistance only, referring any survey data reporting problems to the appropriate experts. Based on this crucial interaction, the staff will be expected to provide feedback to the WCPS; helping identify problems, hone processes, and increase user satisfaction when interacting with the Census Bureau.

6.2 Production System Workload

With this staffing in place, the Census Bureau will be well prepared to handle the emerging demand for the Web CSAQ reporting alternative. The first major test of this new Web CSAQ infrastructure will take place in 2003 when the Web CSAQ is offered to all of the 3.5 million respondents in the 2002 Economic Census.

7. CONCLUSION

The word is out that the Census Bureau can provide establishment surveys with an electronic reporting alternative to the traditional paper mail out/mail back questionnaire. Best of all this alternative has the importing feature, which is perceived by the establishment respondents to significantly reduce their reporting burden. So the demand for Web CSAQ from large companies especially has become enormous. Additionally, since the ACS Web CSAQ test showed that Web CSAQ features such as logic (edits, skipping, branching, auto-calculations, etc.), background information, general help information, and question-specific help reduce respondent error and thus improve data quality, household surveys also have a reason to include Web CSAQ as a survey tool. On the other hand, even though we have seen these proven benefits of Web CSAQ, research still needs to be done concerning the puzzling decline in response rate apparently precipitated by offering Web CSAQ to the ACS and E-Commerce respondents. But in the meantime, preparations must proceed to transition the Web CSAQ from research to a production environment, which is scalable to the needs of the 2002 Economic Census. Let's just hope that between now and then that additional obstacles do not surface such as the security level being raised or the waiver for accessibility being denied. If such a large scale use of the Web CSAQ as the 2002 Economic Census can be accomplished, much will be learned about the advantages and disadvantages of this technology as an electronic data reporting tool.

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