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Summary Report of the FCSM-GSS Workshop on Web-Based Data Collection

Federal Committee on Statistical Methodology

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The Federal Committee on Statistical Methodology
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Expert Consultant

Robert Groves, Joint Program in Survey Methodology

Preface

This volume of the *Statistical Policy Working Paper* series contains summary highlights of the **Workshop on Web-based Data Collection**, sponsored jointly by the Office of Management and Budget's (OMB) Federal Committee on Statistical Methodology (FCSM) and the American Statistical Association's (ASA) Government Statistics Section (GSS). The meeting was held Monday, April 26, 2004, at the Bureau of Labor Statistics (BLS) in Washington, DC.

The Federal Committee on Statistical Methodology

Chartered by the OMB, the FCSM is an interagency committee dedicated to improving the quality of federal statistics. The FCSM was founded in 1975 by Maria E. Gonzalez of the Office of Statistical Policy in the OMB. OMB invited individual statisticians, economists, and statistical program managers working in the Executive Branch of the federal government to participate as members of the FCSM, based on their particular experience and expertise. The initial focus of the FCSM was on recommending standards for statistical methodology to be followed by federal statistical agencies, investigating problems that affect the quality of federal statistical data, as well as making suggestions for improving statistical methodology in federal agencies. Since 1975, the FCSM has published a working paper series, sponsored seminars and research conferences on federal statistics, created ongoing interest groups focused on specific statistical issues, and established a grant program to fund cutting edge research on statistical methodology.

The FCSM carries out most of its work through its subcommittees, program committees, and interest groups:

- Subcommittees are established to explore some particular aspect of statistical methodology and produce a specific product, guidance, or recommendations. A current subcommittee is assisting OMB with the revision of Statistical Policy Directives on Standards for Statistical Surveys and Standards for Publication of Statistics. The FCSM is exploring other topics for examination by subcommittees, as well.

- Program committees are temporary and are established to organize a workshop, conference, or seminar. They may also produce a report in this working paper series to document the proceedings.

- Interest groups are ongoing groups that draw together individuals interested in a common aspect of statistical methods or data quality, so that they can interact, exchange information, explore issues related to the topic, and produce products and services of interest to their members. The FCSM currently sponsors the Confidentiality and Data Access Committee and two interest groups on survey nonresponse – for households and for establishments.

FCSM-GSS Workshop on Web-based Data Collection

In summer 2001, the Administration released the President's Management Agenda – a strategic plan for improving management and performance of the federal government. Among the five government-wide goals the plan spelled out was Expanded Electronic Government. This requirement, among other things, provides that federal statistical agencies should use the Internet for data collection and dissemination. An FCSM Subcommittee on Web Surveys was established to explore the challenges facing federal statistical agencies as they move to Internet data collection and to help identify research issues that must be addressed in the near future. The Subcommittee determined that a workshop would provide valuable input for developing a research agenda. The intent of the Workshop on Web-based Surveys was to bring together experts to discuss issues and exchange experiences on collecting survey and census data over the Internet. A primary goal was to inform, and listen to, OMB staff who direct the government's expanded use of the Web on issues facing statistical agencies in conducting Web-based surveys/censuses.

The Workshop consisted of two sets of concurrent sessions in the morning, providing panel discussions on two parallel tracks – one set on person or household data collections and the other on business surveys. These were followed by a plenary session in the afternoon that reported highlights from the morning presentations, presented some general guidance from the OMB on implementation of the E-Government Act, and provided some preliminary recommendations for next steps.

Attendance at the one-day meeting was limited by invitation to around 75 people. About 20 participants took part in the program, representing federal statistical agencies, academia, and the private sector research community. Topics addressed by the speakers ranged from design, usability, and technology issues to sampling, coverage, and data quality. Mode effects, confidentiality and authentication, response and nonresponse issues, and data editing were touched on under those general topics, as well.

The members of the FCSM Subcommittee, who served as the Planning Committee for the Workshop and are the co-editors of this report, are Gerald Gates (Chair), Wendy Alvey, Dennis Fixler, and Nancy Kirkendall. The ASA's GSS handled registration and logistical matters for the conference. The Committee wants to thank the BLS for use of its conference facility and to especially recognize John Bosley, BLS, who made the physical arrangements for the Workshop. Thanks also go to Brian Harris-Kojetin, Chair of the FCSM, who provided assistance throughout the Workshop and preparation of this report.

For both the Workshop and this volume, the FCSM Subcommittee strived to present a balance between the household and business tracks. However, it is important to note that more progress has been made in converting surveys to Web-based instruments on the business side. This is true, in part, because of the greater facility with technology in the

economic sector, compared with the added complications of access and authentication for the general population. Building general-purpose instruments for the Web that incorporate the detailed skip patterns needed for complex household questionnaires also presents a challenge.

Summary Report

This report presents highlights from the Workshop on Web-based Data Collection, as well as providing some additional background papers that help describe the current state-of-the-art. The report does not pretend to cover either subject in its entirety. Instead, it attempts to focus on some of the federal statistical agencies' most current experiences on the subject and draw some conclusions as to what efforts may be needed next to ensure a safe and successful transition of data collection to the Internet.

Section 1 provides the reports of the rappateurs in each of the concurrent sessions and recommendations for next steps from the plenary session. Section 2 presents three background papers (prepared for other purposes) that are reprinted here with permission from the authors. They helped set the stage for the discussions in each session. Section 3 contains a few electronic links to additional background papers that provide further information on current research in Internet surveys. These papers, plus the references they cite, provide a basic introduction to the current state-of-the-art for federal Web surveys. The contents of all of the papers are the responsibility of the authors – any opinions, findings, conclusions, or recommendations expressed in these materials are those of the authors and do not necessarily reflect the views of the FCSM, the GSS, or the OMB. The material in Section 1 of this volume has been read by the speakers and underwent a limited editorial review; the reprinted papers were reformatted slightly, but the content is unchanged. Although the authors may have originally obtained their own technical reviews, this effort did not include a formal referee process. Corrections and changes were either made by the authors, themselves, or cleared through them by the editor. Final layout of the papers was done by the editor, Wendy Alvey. Minor changes of a cosmetic nature were considered the prerogative of the editor.

This volume will be available electronically via the FCSM Web site at *www.fcsm.gov* .

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Section 1:

Highlights from the FCSM-GSS Workshop on Web-based Data Collection Sessions

Usability and Technology Issues for Internet Surveys of Businesses

Patricia Walker, Bureau of Economic Analysis

Panelists:	Diane Willimack, U.S. Census Bureau James O'Reilly, Westat Tony Labillois, Statistics Canada
Moderator:	Dennis Fixler, Bureau of Economic Analysis

Overview

Shifting away from paper forms and providing respondents an electronic option for completing Government surveys has the potential for reducing respondent paperwork burden and for substantially increasing the speed of the data collection process. More timely responses improve data coverage, particularly for initial estimates, and reduce the revisions between the initial and subsequent estimates. In the paper-based data collection system, editing is performed during the post-data collection processing. Electronic reporting provides the opportunity to perform data editing during data collection. Data editing during collection has the potential to improve data quality by limiting item nonresponse and data inconsistencies. Also, electronic reporting reduces costs associated with data conversion and handling of paper forms (printing, mailing, keying of data for example) and reduces errors associated with manual data entry.

While expectations were high that respondents would embrace and use electronic filing modes for reporting on Government surveys, many federal agencies have experienced disappointing response to electronic reporting and found that maintaining yet another reporting mode is time consuming and costly. *So what can we – as providers – do to encourage respondent use of electronic filing?*

The panelists focused on two key topics: design and privacy and security of Web-based data collection.

Design Issues

First, respondents' attitudes toward electronic reporting can be positively influenced by a strategic approach to conversion to Web reporting. Web reporting software development should not be aimed at developing a system that meets only the requirements connected to a limited number of known or assumed circumstances and preferences, but at developing a flexible system adequate in circumstances not known beforehand. This will facilitate growth as our technological abilities increase. Second, design of electronic surveys must keep the respondent "in the game." If the system is too cumbersome, we will lose the respondent's participation altogether. Offering continued support until the respondent demonstrates confidence in Web reporting may be required to accomplish the

conversion from filing on paper forms. If respondents can be convinced to try Web reporting, it is likely that they will adopt this method long-term.

Finally, paper copies of survey forms will continue to be a tool for respondents. Web and paper versions of survey forms should look alike. Data collectors should design the Web version of the survey form and pattern the paper version after the Web version.

Privacy and Security

Maintaining confidentiality and preventing unauthorized access to data reported on Web-based surveys are at the heart of respondents' concerns. Concerns about data security can be a deterrent to acceptance of electronic reporting. While management's acceptance of Web-based surveys hinges on confidentiality protections, the people completing the survey are mainly concerned about ease of use. Therefore, security features must be transparent to the person completing the survey.

Looking Forward

The expectation is that, in this age of technology advancements, electronic filing options will become more available and more sophisticated. Just as paper is here to stay (for the time being), electronic filing is here to stay. If federal agencies need to collect data, they need to offer electronic options.

Fortunately, feedback indicates that respondents like some aspects of electronic reporting:

- People like to use computers
- Web-based reporting is neater and data quality is better than on paper surveys
- Respondents have more confidence in the security of transmitting data electronically than in sending reports in the mail.

Data collectors need to capitalize on these positive reactions to increase respondent use of electronic filing. Web-based data collection systems need to be easy to use and secure, and maximize the use of edits during data entry.

Coverage and Quality of Web-based Business Surveys

Paula Weir, Energy Information Administration

Panelists:	Sam Best, University of Connecticut Tim Gable, Research Triangle Institute Bill Mockovak, Bureau of Labor Statistics
Moderator:	Nancy Kirkendall, Energy Information Administration

Overview

This session focused on three components of Web data collection for business surveys – coverage issues/mode issues; data quality issues/response issues; and implications for interactive editing. The panelists drew on the experiences of their agencies as case studies to demonstrate the successes and challenges they had faced in implementing Internet versions of their surveys. In so doing, they focused on a number of common themes, including the importance of a help desk (phone, email); federal accessibility requirements; instrument costs; priorities and social presence; different kinds of response error; and mixed mode effects.

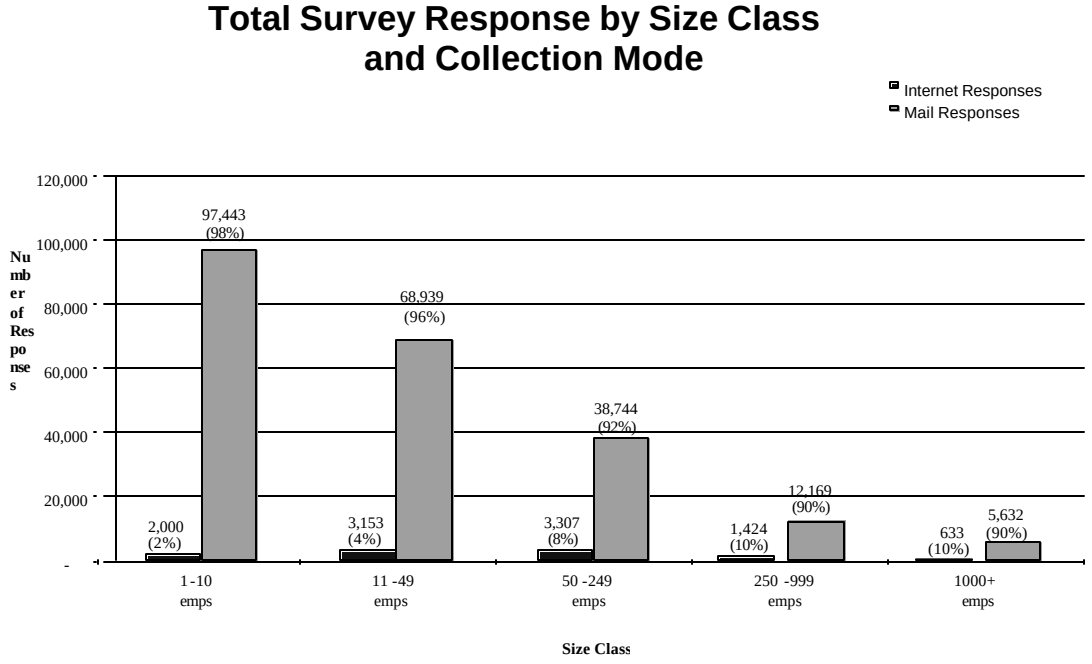
Coverage Issues/Mode Issues: A Case Study

The session began with a brief history of the Bureau of Labor Statistics' (BLS) Internet Data Collection Facility (IDCF), which was developed by BLS to provide their survey respondents: one entry point; common look and feel; ease of use; security; support for multiple surveys; and, a place where users have the capacity to add/delete surveys, attach electronic files, and access help easily. The IDCF has been implemented as an option for reporting in the Current Employment Statistics Survey (a monthly survey) and the Survey of Occupational Injuries and Illnesses (an annual survey). Two other surveys are being piloted and three more are planned in the future. Security measures used include Personal Identification Numbers (PINs)/passwords and digital certificates, with roughly 16 percent of respondents choosing to use digital certificates. In the case of the annual survey, voluntary usage increased from 5 percent the first year to at least 17 percent in the second year. For the monthly survey, usage is roughly 3 percent, but respondents are specifically targeted for this mode of response, and it remains optional.

The appeal of Web collection to the BLS included: improved data quality editing, timeliness of data, lower costs, latest technology, and, hopefully, higher overall response. The agency found that, as establishment size increases, the percent of respondents voluntarily choosing the Web option goes up, and, in the case of the survey reporting injuries and illnesses, more incidents per establishment are reported on the Web versus on

paper forms. (See Figure 1.) From the respondents' viewpoint, Web options offer greater availability (24 hours/7 days a week) of the system, better accessibility for assistance, recognized benefits to the government, novelty, and, possibly, ease of access and ease of use.

Figure 1. Mode Effects on Response Rates*



* From presentation by Bill Mockovak

On the other hand, the drawbacks to survey managers included: possible complications arising from integration and management of survey operations for multiple data collection modes, possible mode bias, higher up-front costs, more help-desk support required, the necessity to satisfy the Americans with Disabilities Act, Section 508 requirements that information on the Internet must be accessible to persons with disabilities (is the option of phone mode sufficient?), the challenges of ensuring security, and the potential for lower overall response rates. Despite these concerns, a cost comparison found that unit costs of Web collection for the Current Employment Statistics survey ($1/unit) compared favorably to other modes – Computer-Assisted Telephone Interviewing (CATI) (over $6), mail ($2), facsimile (just under $2), Touchtone Data Entry (just under $2), and Electronic Data Interchange (EDI) (less than $1).

Despite the apparent success of the BLS case studies, there are a number of hurdles that limit Web usage. These include: security and access – correctly signing on, creating acceptable passwords, understanding and obtaining digital certificates, remembering the password and entering it correctly; compatibility with the users' browsers; a survey

design that works with the users' hardware; concerns about confidentiality; and data collection instrument usability and design. In addition, survey managers must consider such issues as: Should the Internet version mirror the paper form? When and how many edits should an electronic instrument employ, when, and how should they be displayed? What is the best way to set up navigation? Do respondents prefer page-by-page design vs. scrolling?

It is also important to remember that the skills of users are still an issue and clear instructions for a variety of skills are necessary. Possible mode effects should be considered in terms of priorities and choices. In addition, designs should recognize that a significant number of users have low speed connections. Furthermore, because of significant up-front costs, the frequency of a survey's collection impacts the economics of developing a Web survey.

Data Quality Issues/Response Issues

Next, the session turned to data quality and response issues. Three types of establishment surveys carried out on the Web by the Research Triangle Institute (RTI) were described: establishment-level reporting, respondent-level within establishments, and a hybrid of establishment and respondent-level data. These establishment surveys pertain to secondary and postsecondary schools/institutions, businesses, and clinical sites and grantees.

First, it was pointed out that, while Internet penetration in business provides reasonable coverage, it is still not ubiquitous. Broadband availability is increasing, but there is no guarantee of Internet access. Second, it is important to bear in mind that, in establishment surveys, EDI and direct data transfer are already viable alternatives; in fact, they may be seen as more desirable for some respondents. XML and data standards technology could dramatically improve the efficiency of direct data transfers. The implication is that more time could be spent studying these issues rather than focusing on Web data entry.

Nonetheless, there are definite pros and cons to offering an Internet option. With respect to data quality, the Internet offers an improvement over paper-based questionnaires through the use of real-time edits, database lookups, radio buttons and check boxes (rather than typed responses), and the ability to monitor data for trends through a central server. Changes to the data collection can be made quickly. However, four issues were raised that data collectors need to consider:

- The first regards response rates. Eliminating or reducing interviewers may be detrimental to response rates; self-administration can result in more break-offs.

- The second issue is record completeness – item nonresponse may become more prevalent. How should one handle Don't Knows and refusals? Should there be explicit choices or is a blank acceptable?

- The third issue pertains to the reduced instrument complexity compared to CATI. With Web surveys, there is no training, so usability must be simplified. The instrument must depend on soft- rather than hard-edits, and it may overuse consistency checks, resulting in break-offs. In addition, the data collector has to deal with performance issues regarding server vs. client-side logic. Section 508 requirements can also lead to a design that "dummies down"' the questionnaire to ensure compliance.

- The fourth issue is population coverage. Not all respondents can participate by Internet, and infrastructure differs by respondent.

So, if part of a mixed mode survey, the Web version may create mode differences. Remember, also, that multi-mode surveys result in more data quality issues, since more extremes exist and respondents respond differently with visual cues. The skill of the users is still an issue.

To avoid some of these problems, data collectors should:

- Anticipate – think in advance about primary issues and plan accordingly
- Evaluate – embed mode studies and conduct usability testing
- Assess the results – compare data quality metrics (e.g., item nonresponse, frequency distributions, and univariate statistics).

It was also mentioned that RTI was surprised at the degree to which a Help Desk is required to answer questions from respondents. Several staff members spend their days answering emails. It is important to maintain a strong Help Desk to improve data quality and maintain respondent engagement through quick turnaround to questions.

Data collectors are also encouraged to take on more of a leadership role with respect to federal accessibility requirements and become more forward-looking.

Implications of Interactive Data Editing

In any mode, there are response errors that result from either the mechanism – the collection mode, interviewer, or instrument itself – or from respondent actions – keypunch errors, miscalculations, misunderstanding, or intentional deceit. Response errors come in two forms – invalid responses (out of range and untrue responses) and missing responses (no response and "Don't Know"). The purpose of data editing is to detect and correct response errors, limiting their contribution to the total survey error. Internet data collection permits interactive editing of responses to reduce respondent-based response errors. Priorities and strategies for editing are needed, though.

The advantage of interactive editing is that respondents are involved with data verification, thereby reducing the time, personnel, and costs of post-editing activities. This can reduce the burden on respondents in the post-data collection phase.

Additionally, external information can be incorporated into the editing process, reducing respondent burden and minimizing costs.

The problems associated with interactive editing include high fixed costs for programming and questionnaire testing, the potential for over-editing, increased response completion time, a greater perception of social presence, and the introduction of new errors in the data.

An overall strategy and a typology for editing decisions are necessary, not just a question-by-question approach. The challenges in designing the editing strategy revolve around:

- The type of edits (e.g., format, conditional, consistency edits)
- The amount of edits (i.e., determination of priorities)
- The optimal timing of edits (after each question or just before the questionnaire is completed) with respect to recall vs. burden
- The presentation of edit failures to respondents
  - Wording of error message (especially ones calculated by the system)
  - Design and format of the message (e.g., color, background, etc.)
  - Usage of hard edits (forced to fix in expected manner) or soft edits (either reconcile the error or provide comments)

- The design and management of previous or complementary external information
- The help facilities provided (e.g., additional instructions, telephone support, email responses).

Seven lessons learned from prior research that address these challenges were provided:

Figure 2. Electronic Data Editing – Lessons Learned*

1. Not every error warrants editing – Is there value in correcting typographical errors in open-ended questions?
2. The type of edit chosen should depend on the type of response error and priorities of the study. Keep it simple.
3. Edits should be used only in limited situations (e.g., impossible occurrence) to ensure continued cooperation.
4. Soft edits should give respondents a mix of choices – fix the failed data, save the failed data, explain the situation in a remarks box, access the Help screen.
5. Edits should be limited, to ensure respondents continue to cooperate.
6. Edits should not be confrontational.
7. Edits should be consistent across the instrument.

*From presentation by Sam Best

In the RTI surveys, the preference is to perform edits along the way, rather than at the end of the survey. They use item-specific Java script on the client side. Pop-up boxes alerting respondents to data inconsistencies are the most difficult to implement. Key items are checked for no response. A strategy for avoiding nonresponse to key items in a mixed mode study eliminated the Don't Know (DK)/Refusal as an on-screen option, to be more consistent with the CATI/CAPI (Computer-Assisted Personal Interview) version. If a Web item was blank, a follow-up screen presented an explanation of why the item was important, and the question was re-asked, still allowing a DK option. This approach resulted in 90 percent converted from blank to either valid responses or explicit DK. Of those, 70 percent were valid, 20 percent were DK, and 10 percent remained blank (assume Refusal). If the collection mechanism accepts direct data transfer, the data collector needs a mechanism for running data checks before accepting the submission. Ideally, this step should be built in as a required action before submitting (e.g., *TurboTax* reminds tax filers to "check return for errors").

Discussion followed on a strategy of minimal editing, using soft edits to minimize respondent burden. Some participants suggested there should be a button to choose to perform edits. Also, the question was asked if respondents should fill in totals or the system should automatically tally results. If the system fills in the total, the consensus was that respondents should be allowed to type over the amount. There was general agreement that hard edits should be reserved for impossible situations or critical/fatal errors with respect to the rest of the questions or the ability to capture the data.

With regard to the use of incentives to improve data quality, the panelists were asked if there are any incentives being offered, other than refunds in the case of income taxes? No examples were available.

Further discussion was held on Section 508 compliance. Some felt it is not unreasonable to adopt accessibility standards to meet the needs of the disabled; it is clear, however, that agencies are interpreting the federal law differently. There was also concern expressed about the Internet connection coverage and the variety of configurations. Other comments dealt with respondent profiles in business surveys. The notion of filling in surveys with dead time versus dedicated time may affect business Web surveys differently than household surveys. Business survey respondents frequently must query their own databases before answering the question on a Web form, and, therefore, tend to gather the data to paper first, before keying them in on the Web form. At any rate, the Internet collection should specifically state that the data are used only for statistical purposes and the data are protected. One participant also noted that some surveys require multiple respondent contacts for sub-elements within a survey. This requirement led to the use of different views according to individual roles in a company to protect the data confidentiality within a survey response.

Another participant asked if anyone is adjusting for nonresponse by mode. No examples were given. It was noted though that an FCSM-sponsored Interest Group currently exists that is studying and sharing information about response error in surveys. This group is the Interagency Response Error Group (IREG), which is composed largely of

representatives from cognitive laboratories in the federal statistical system and researchers interested in measurement error. IREG also has a subgroup that is investigating issues involved in Web usability. IREG and the Web subgroup could work with FCSM toward improved understanding and possibly standardized solutions.

Design, Usability, and Technology Issues Related to Person/Household Web Data Collection

Nancy Bates, U.S. Census Bureau

Panelists:	Roger Tourangeau, Joint Program on Survey Methodology, University of Maryland Jocelyn Burgess, Statistics Canada Betty Murphy: U.S. Census Bureau
Moderator:	Wendy Alvey, U.S. Census Bureau

Overview

This session was structured around three broad topics in Internet survey data collection: Web design and mode effects, privacy and confidentiality concerns, and security of responses and authentication. The session began with a reminder that the FY 2002 President's Management Agenda called for expanding electronic methods to improve management and performance of the federal government. One means to do this is through broader use of electronic reporting – including offering respondents the opportunity to answer government censuses and surveys via the Web.

Web Design and Mode Effects

The first presentation provided a discussion of usability and design issues in Web surveys. It noted that the Web, as a new medium, is like other media in some ways (uses textual 'pages'), but not the same in other ways (has hyperlink capabilities). The Web offers a blending of technologies and great diversity in how information is displayed. Two design traditions have begun to emerge – static versus dynamic. A static Web design emulates paper, while the dynamic approach explores inherent Web features that may help reduce measurement error. For example, automatic edits, help, or definition capabilities are available in a dynamic design and may help improve data quality. A critical area of needed research is to better understand which features are useful under what circumstances and which are not.

To illustrate the impact of design effects, a case study was described that tested different visual presentations of answer categories – radio buttons versus different drop box formats. (See Figure 3.) The researchers found that respondents attend to what is visible and, as a result, response formats can change the way a respondent selects answers.

Panelists cited another general finding from Web usability testing – that the majority of respondents did not tend to use help screens. This is particularly true if the help function required extra user interventions. One study found that only about one in six respondents

Figure 3. Sample Web Survey Design Options*

*From presentation by Roger Tourangeau

used help definitions. It was suggested that help screens in the form of mouseover functions work best, but designers should be mindful to balance simplification with providing aids. If a help definition is not on the 'critical path,' it tends to get ignored. The discussion also included a question about the use of built-in coding help with open ended formats. Examples were provided of how this worked for a survey of doctors entering prescription drug names.

Privacy and Confidentiality Concerns

Next, discussion focused on electronic data reporting (EDR) at Statistics Canada. Canada initiated Government on Line (GOL) to accelerate services via the Web. A study indicated that 80 percent of Canadians had access to Internet at home or work and that a large majority would be 'very' or 'somewhat' interested in completing surveys online (80 percent for business surveys; 75 percent for household surveys).

Some of the biggest concerns about EDR are confidentiality worries and fear of unauthorized access. Going into the GOL project, several key assumptions were made: security is critical, access must be restricted to authorized users, EDR applications must be user friendly and not affect respondents systems (e.g., not require downloading of software), and automatic edits would be minimal. Respondents were sent an email and directed to a URL to participate.

Statistics Canada found that the average 'take-up rate' (similar to a response rate) was around 30 percent for business and agricultural surveys, with a lot of variability in between (some much higher and others much lower). Canada is finding it is much more difficult to identify household surveys willing/able to offer an EDR option. Consequently, most surveys require a multi-mode approach. Efficiencies of using EDR for household surveys are hard to identify – infrastructure costs to build the EDRs are very high. While it's possible to build relationships with businesses, it is much more difficult to do so on the social (household) side. However, there is evidence that EDR response is faster and the data quality is better.

A recent survey suggests that 74 percent of Canadians are confident the government is able to protect information submitted online. However, 70 percent still have concerns about conducting online transactions that require personal information and 49 percent are not comfortable with data sharing of personal information among agencies.

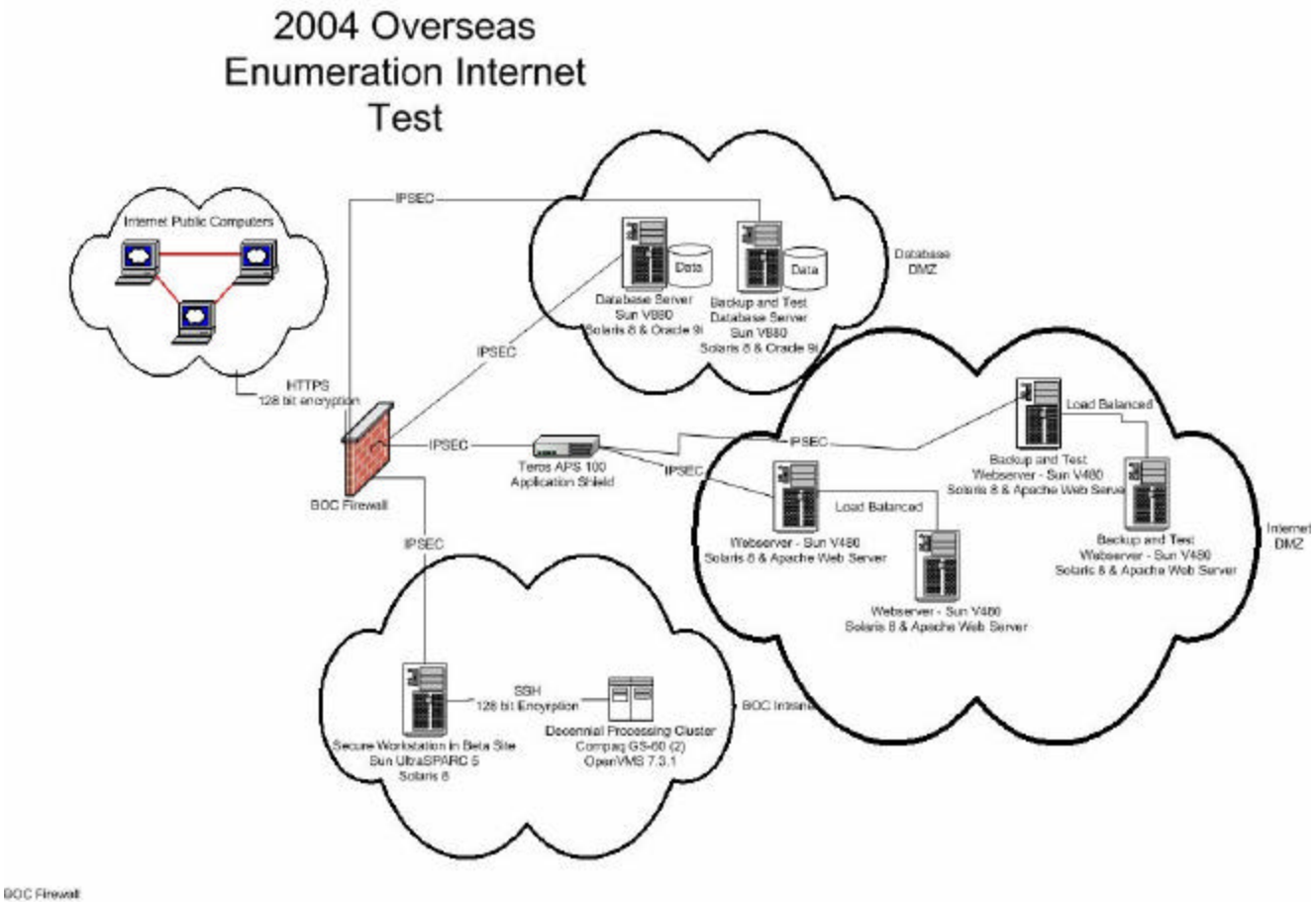
Statistics Canada will be identifying potential social surveys for EDR applications in the near future. Further research is needed to better understand confidentiality concerns and how to make the switch from EDR for business surveys to household surveys. Canada also needs to adapt paper surveys to better fit the Web interface (at present, Statistics Canada has not gone beyond making online surveys emulate the original paper forms). Finally, the Canadians need to determine what the key messages and communication vehicles/media are that will increase the 'take-up rate' for EDR among households.

During discussion, it was suggested that built-in control over skips and fills can make a complex survey on the Web look much less intimidating, that open-ended questions get better responses, and social desirability bias is much less. It was pointed out, however, that people may be less candid on the Web, because of confidentiality concerns. Web surveys may not always be faster, either, because of all the authentication steps built into the front end to ensure restricted access.

Security of Responses and Authentication

The session concluded with a presentation on security of Web responses. It was noted that we are facing a paradigm shift in protecting data on the Web. Previously data collectors only needed to be concerned with data protection after receipt. With Web surveys, it is critical to protect data *during* the data collection process, as well.
The basic security provisions for Internet data collection were described, including: minimum of 128-bit encryption and secure socket layer protocol (SSL version 3). Figure 4 provides a diagram of the security in place for the 2004 Overseas Enumeration Internet

Figure 4: Example of Data Security for Web Data Collection*



*From presentation by Betty Murphy

Test. It presented 10 vulnerabilities in Web applications, including: unvalidated parameters; broken access control; broken account and session management; cross-site scripting flaws; buffer overflows; command injection flaws; error-handling problems; insecure use of cryptography; remote administration flaws; and, Web server misconfigurations.

How do security provisions impact respondents? First, during the authentication process; that is, respondents must have access to a valid identification number. Second, there are usability issues – where to find the number, ease of entering, and clarity of instructions. And finally, there are accessibility issues.

Examples were provided of how authentication can go awry. For instance, a 22- digit identification number was required during the 2000 Decennial Census and the biggest hurdle for respondents was finding the number, not necessarily entering it. The authentication screen had a 5-minute expiration timer and a warning about "reckless" use and punishment for misuse. In the 2003 National Census Test, a 14-digit identification number was required and parsed into 3 fields. Many respondents erroneously believed the survey was requesting their Social Security Number, because of how the 3-parsed fields were displayed with dashes in between fields.

Another important consideration is how to tell respondents their data have been successfully transmitted (returning confirmation messages). Respondents can get concerned unless they are confident their data were received. One relatively easy way to reassure respondents about data security after they send their information is to reply with a confirmation message – or, even better, a confirmation number.

The session ended by raising a number of questions about security procedures for Web-based surveys. One concern is that authentication steps add respondent burden to the front end of surveys, while making certain that the applications are secure – how can we make this process less cumbersome and still satisfy security requirements? How can we better reassure reluctant respondents about the security of their data? To what extent are security concerns actually depressing Internet response rates?

Sampling (Coverage) and Quality of Person/Household Internet Surveys and Censuses

Nancy Bates, U.S. Census Bureau

Panelists:	Reg Baker, Market Strategies Norman Nie, Stanford University Mark Pierzchala, Mathematica Policy Research
Moderator:	Gerald W. Gates, U.S. Census Bureau

Overview

Recent studies have suggested Web surveys may "not yet be ready for prime time." Uncertainty surrounding Web surveys includes: coverage problems, measurement error, and difficulty to use as a stand-alone method. The panelists in this session were asked how their organization is currently using the Web and what the biggest concerns are related to population coverage and data quality.

All three participants described multi-mode approaches. One panelist mentioned an SPSS-sponsored test of three modes – telephone, Internet, and convenience sampling. He noted that, if you use probability-based sampling, you can overcome low response rates. At Mathematica Policy Research, multi-mode projects involve Computer-Assisted Telephone Interviews (CATI), paper, and the Internet. In this case, coverage is not an *overall* issue; the main concern is coverage *within* each mode. Browsers and bandwidth are also a concern. It was pointed out that, if you reduce everything to the lowest common denominator, you limit the Web's capabilities. It is a tradeoff between taking advantage of the Web and being accessible to many users.

About 20 percent of Market Strategies' revenues involve the Web in some way – pure Web surveys (such as pharmaceutical companies/college students), transitional (mixed mode surveys), or methodological work on Web data collections. It was noted that, compared to telephone surveys, the Web sometimes produces "different" results. A number of issues contribute to this –

- Sampling differences – the Web usually requires non-probability sampling
- Mode effects – the Web uses different displays
- The characteristics of Web users – users are different from non-users. Recent analysis suggests a leveling-off in the number of people using the Web. Internet survey researchers are also encountering Web-rejecters – those who tried it and do not like it. It is possible that we may be stuck at this level of Web users for some time.

Compensating for Non-probability Sampling Bias

Discussion then turned to sample selection as a component of data quality. As more traditional data collection methods face new challenges, the Internet may be the way to go. For instance, one panelist pointed out that we are losing our telephone probability frame, because of such factors as cell phones, other technological devices, and the "do not call" legislation. Furthermore, field work for phone surveys is getting more expensive; one third to one half of the population are now considered "cooperators," while everyone else is a "refuser." The Internet also offers an advantage, because it is self-administered and, hence, has no interviewer bias. The Knowledge Networks' approach involves recruiting people and giving them a computer to use to respond to Web surveys. While this might improve coverage rates, it still depends on the telephone, which has the problems noted above. Nonetheless, for customer satisfaction and other list surveys, the Internet may be the best method of data collection.

A member of the audience then inquired about the recent 'do not call' sign-up list. Millions signed up via the Website – does government have access to that list or is it restricted? Could government do a confidential analysis of that list to study sampling bias? Some problems with this – besides ethical considerations – include the fact that the list is self-selected and it contains only one of multiple addresses a person might have. Generating *random* lists of emails also raises big concerns. In fact, the recent advent of SPAM filters has made use of random email address lists much less feasible.

Just as CATI was initially developed by the private sector and then further adapted and expanded by government and academia, the government sector was challenged to pioneer research into non-probability samples for the Internet. It was pointed out that we are at a similar juncture for Web surveys. Private sector methods may not be "good enough" for official statistics. Advanced propensity type weighting schemes could be developed and government should be taking the lead, because the commercial side is not likely to make a big investment in this type of research.

Web-only vs. Multi-Mode Approaches

The panel was also asked to comment on its experience/studies using the Web as part of a multi-mode approach. One example cited was a case of Web versus CATI, where a Web response option was created for a survey. While it helped add young people to the survey, analysis showed that the researchers could never get the Web respondents to "look" like the CATI respondents on important behavioral indicators, like smoking. It was suggested that such mode effects could have been driven by how the data were presented (e.g., presenting a visual cue versus audio).

In another case, researchers wanted to move an establishment survey to the Web. They started with a mail-out notice that asked respondents to visit a Website. It worked well for the biggest establishments, because it circumvented the usual gatekeepers encountered by telephone.

Discussion then turned to the unique challenges in doing a Web-only versus multi-mode survey. From the Web-only perspective, it was suggested that the Web is easier for respondents, since skips are controlled and it is fast. Surveys where you have an extremely motivated population may be especially good candidates for a Web survey (e.g., people suffering from an particular condition, such as diabetes, are a highly motivated population for a survey about diabetes). On the other hand, management of a multi-mode survey is more difficult, because it is hard to make a CATI, paper, and Web survey parallel. Also, the complexity of dealing with the Web is greater than other modes, because so much of the hardware and software infrastructure is beyond the control of the survey-taking organization. Consequently, if a Web option is used within the context of a multi-mode survey, browser aspects such as display and use of Java Script must often be "dumbed down" to the lowest common denominator. The bigger net you cast (in terms of general population setup), the blander you must be. At a minimum, you must "do no harm" with plug-ins, cookies, etc.

Design Issues and Editing Capabilities

Another advantage of Web questionnaires is the flexible design and ability to conduct electronic editing. Among the pluses cited are the routing capabilities, skip patterns, and built-in edits. Data entry errors are dramatically reduced in Web surveys and open-ended responses are often much longer, making these data easier to code and analyze. It is important, however, not to over-do consistency edits, lest you turn respondents off. In the case of automatic edits, less may be more. Research suggests that Web instruments do a good job of keeping respondents on-path, and this reduces the vast majority of data cleaning problems.

Incentives to Encourage Response

In traditional surveys, some research organizations have experimented with incentives to improve response rates. The panelists were asked if this option is being used for Web surveys. It was noted that sweepstakes are a common technique to get people to participate in Web surveys. But, this is not adequate for populations that are routinely underrepresented in surveys. It was suggested that, on the whole, incentives in Web surveys may have to be larger than they are for modes that have some type of human interaction – e.g., personal visit or telephone surveys. Another issue yet to be resolved is *how* best to offer and administer Web survey incentives. The Knowledge Networks model is one approach, whereby the incentive is up front for some populations (use of a computer). Since you know exactly where respondents reside, it's easy to deliver other incentives later on.

A less tangible incentive is the flexibility of the Internet. It was also noted that respondents are often pressed for time, and the Web allows them to determine when to complete a survey. It is not uncommon to see Internet surveys being completed between the hours of 9:00 p.m. – 10:00 a.m. – times that are usually off-limits for telephone and personal visit surveys. This flexibility also makes Internet surveys an excellent option for

data collections involving respondents overseas or in outlying areas, because of the time differences.

Another "incentive" is the reduced amount of time it takes to complete the questionnaire. On average, respondents tend to stay with a Web survey about 20 minutes before breaking off. Unfortunately, this may not be long enough for most government surveys. It was noted, though, that Web surveys can be completed in less time than CATI or personal visit surveys and that Web surveys can be programmed to be completed piece-meal rather than all at once.

In Summary

Most panelists agreed that the Web introduces mode effects that can impact data content and quality. These can be positive – i.e., controlled skip patterns, built-in edits, no interviewer bias – or potentially negative – e.g., Internet displays and response formats that can cause measurement error. Another common theme was the problem of making Internet surveys work for the largest number of users. In doing so, the very function and features that make a Web survey attractive may have to be sacrificed or minimized in order for the application to run on the "lowest common denominator." Along these same lines, when adding the Web as an option in a multi-mode survey, the Web has to be mindful of Web browser and infrastructure constraints, in order to parallel as close as possible the other modes (e.g., a paper questionnaire or phone survey). A final common theme was the subject of incentives. Several of the panelists expressed concern about how best to offer and deliver incentives in Web surveys, given the absence of human interaction. Research on this topic would be welcomed. Finally, it was the opinion of the panelists that it is time for the government sector to take the lead in developing methods to deal with the non-probability sampling associated with most Web surveys.

Research Agenda for Web Surveys

Roger Tourangeau, Joint Program in Survey Methodology,
University of Maryland

Panelists:	Paula Weir, Energy Information Administration Patricia Walker, Bureau of Economic Analysis Nancy Bates, U.S. Census Bureau Jeanette Thornton, Office of Management and Budget Roger Tourangeau, Joint Program in Survey Methodology
Moderator:	Brian Harris-Kojetin, Office of Management and Budget

The focus of the afternoon session at the Workshop on Web-based Data Collection was to draw together information from the business and household surveys tracks in the morning and use that information to identify some next steps the OMB and the FCSM should consider to support Internet data collection in the federal government. This paper presents some research issues for the statistical community to consider in the near term – with an emphasis on household data collection.

Next Steps for Person and Household Surveys

Coverage and Nonresponse in Web Surveys

There is often a tradeoff between poor coverage (at least of the general population) and poor response rates in Web surveys. That is, it is easier to get high response rates with captive populations (e.g., students at a single university or employees at a single company) or with volunteer samples than with samples that yield good coverage of the general household population or other large populations of interest. For example, the Knowledge Networks experience suggests rigorous sampling methods can often yield relatively poor overall response rates (taking into account all the steps in the recruitment and data collection process). This situation suggests six areas for further research:

1. Statistical methods for compensating for poor coverage (such as propensity models) – There is very little published work applying such methods and they need to be rigorously evaluated. When, if ever, can we be comfortable using model-based methods to compensate for poor sampling methods?

2. Methods for compensating for poor response rates in Web surveys and for assessing whether the poor response rates imply high levels of nonresponse bias.

3. Procedures for producing higher response rates in Web surveys – The study of methods for boosting response rates in Web surveys is in its infancy. This research

would look at methods of contact, methods and timing of follow-up contacts, use of incentives, and so on. The goal here would be to produce a counterpart to the literature on getting high response rates in telephone, face-to-face, and mail surveys.

4. Incentives in Web surveys – It is difficult to deliver cash over the Web. Research needs to investigate the most effective methods for providing incentives to Web samples and the best payment vehicles for such incentives.

5. Methods of sampling for Web surveys – A big challenge for the coming years is developing better frames and better methods of sampling the general population for Web surveys. At present, there is no Web equivalent to Random Digit Dialing (RDD) methods for telephone sampling. If the Web is ever going to be used for high quality stand-alone surveys of the general population, we need to develop frames and sampling methods that will yield acceptable coverage.

6. Preference for other modes in mixed mode surveys – Often, when sample members are given the choice among several modes of responding, the Internet is the least popular. In fact, when the Internet is added to the mix of possible response modes, response rates sometimes go down. Are there subpopulations more favorable to the Internet? Why do people prefer other modes? Why does adding Internet to the mix depress response rates?

Measurement Issues in Web Surveys of People and Households

The Web is a medium that is similar in some respects to earlier methods of data collection, but is not identical to them either. The measurement properties of Web surveys are very poorly established. At least four areas require additional research.

1. Optimal design for Web questionnaire – How can we take advantage of the immense capabilities the Web offers (for color, video, sound, interactivity, programming power, etc.) without tossing out much of what we've learned about questionnaire design from earlier modes (such as paper self-administered questionnaires)? How can we combine the best features of the two design traditions that have already developed for Web surveys (the static approach, which mimics the design of paper questionnaires, and the dynamic approach, which mimics the design of Computer-Assisted Personal Interviewing or ACASI applications)? What factors determine which design approach is more appropriate?

2. One of the great advantages of computerization of data collection is the potential to provide various forms of help to the user (such as definitions, tallies, consistency checks). A consistent finding is that neither interviewers nor respondents take advantage of such features. More research is needed to determine how respondents can be encouraged to use the help they are offered and to determine the impact of such features on data quality.

3. Although it has multimedia capacities, the Web is largely a visual medium and we are still learning how the visual presentation of the questions affects the answers. What visual cues do Web respondents pick up on and how do these affect their interpretation of the questions or processes through which they formulate their answers? Results suggest that there are differences between visual and auditory presentations of the questions and between the visual issues raised by Web surveys and those raised by more traditional methods of visual presentation (such as paper questionnaires).

4. Systematic research on mode differences – More generally, we need systematic research on the key variables underlying mode differences for different types of questions. For example, Norman Nie has argued that Web surveys are generally both faster for respondents and yield more thoughtful, accurate answers. However, Web respondents seem to take significantly longer to answer open-ended knowledge questions than telephone respondents. The material they provide is presumably richer. We need much more research relating the properties of the different modes to their consequences for different types of questions.

Contemplating Research Issues Related to Collecting Establishment Survey Data via the Web

Diane Willimack, U.S. Census Bureau[1]

In order to maintain the balance in this volume between establishment and household surveys, we are including the following summary of the last session's discussion on Web data collection for establishments. It highlights points made during the floor discussion and subsequent to the meeting that need further research.

Introduction

Martin (2003) concluded that Web reporting, along with other types of electronic options, is currently at a stage of development and adoption in both household and establishment surveys that "knowledge gained in one may shed light on problems in the other." Establishment surveys have been offering electronic reporting options since the late 1980's, and are, perhaps, further along the learning curve than household surveys. Nevertheless, establishment surveys share many of the research concerns that Roger Tourangeau suggested for surveys of households and individuals. These include:

- Methods for improving response rates (or take-up rates) in Web surveys;
- Reasons respondents prefer modes other than the Web in mixed mode surveys;
- Alternative designs for Web instruments and conditions under which each is optimal;
- Electronic functions designed to aid respondents and ease respondent burden;
- Effects of visual presentation on survey questions and respondents' answers; and
- Systematic research on mode effects and data quality.

While these topics are certainly pertinent to establishment surveys, their context and application may need to be adjusted to accommodate the establishment survey response process. In addition, the following potential research areas relate to factors more likely to be encountered in establishment surveys than household surveys.

Response Task Analysis

Successful user-centered software design begins with a careful detailed analysis of user tasks and activities that automation is expected to aid, or perhaps even replace, along with user needs that the software is expected to fulfill. For a survey, the user is the

[1]This report is released by the U.S. Census Bureau to inform interested parties of research and to encourage discussion of work in progress. The views expressed on methodological issues are those of the author and not necessarily those of the Census Bureau. The author wishes to express her gratitude to the Interagency Response Error Group's Web Subgroup members: Karen Goldenberg and Jean Fox of the Bureau of Labor Statistics and Carl Ramirez of the U.S. General Accounting Office, for their substantial and thoughtful contributions to the research issues suggested in this paper.

respondent. For establishment surveys, the response task involves a number of activities and routines usually not found in household surveys (Sudman et al., 2000).

Establishment surveys typically require retrieval of data from business records, many of which are automated. However, depending on the type(s) of data requested by the survey, these records may be distributed throughout the company, in different locations and/or systems, accessible by different people. So a sort of "omnibus" establishment survey collecting data on multiple topics often requires multiple respondents and retrieval from multiple data sources.

In addition, many establishment surveys conducted by the federal government are repeated with regular periodicity – e.g., monthly, quarterly, annually. Research has shown that many business respondents maintain documentation of the government forms they file, retaining copies of completed forms and supporting notations, in order to maintain consistency from one reporting period to the next (Sudman et al., 2000).

These and other activities carried out by establishment survey respondents challenge the design of software for electronic reporting – e.g., Web surveys – to support, facilitate, or, at least, not hinder these activities. Specific research questions include:

- How could/should Web survey instruments be designed to facilitate circulation among and completion by multiple reporters in a company? What sorts of "copy and distribute" functionality do business respondents desire or require? How much flexibility could/should be enabled? How can the Web instrument support internal company controls and restrictions on data access when different reporters supply different pieces of data? How should the interface be designed to make this sophisticated functionality usable and transparent to business respondent(s)?

- Since many business records are automated, can Web survey instruments be designed to interact seamlessly with electronic data systems? What software and security specifications would be required to make this happen? What are the consequences for Web data collection when businesses purchase automated record-keeping services – e.g., payroll processing services – rather than maintaining systems onsite?

- How could/should Web survey instruments be designed to support the company's ability to retain documentation of their completed reports? In addition to retaining a copy of completed report forms, how can the Web instrument facilitate keeping notes? In what medium (paper or electronic) do companies want to keep documentation and what do they want it to look like?

- How does desired functionality differ by the size and industry of the company? How could/should Web survey instruments be designed to accommodate these differences?

Respondents' Use of Electronic/Web Survey Instruments

Once we know more about the respondents' activities for completing establishment surveys, regardless of mode, suitable functionality can be designed into the electronic data collection instrument. In order to ensure the usability of this functionality, research is needed to understand how respondents want to use the instrument. Sophisticated functionality has little value if respondents cannot figure out how to use it, if it doesn't work in the manner expected, or if it contributes to confusion.

The content of some establishment surveys is highly tailored by industry. Establishment surveys also differ in their desired reporting units and the level of data requested – e.g, establishment level data, company level data, data distinguished by activity or industry. As a result, large diverse companies may be required to complete multiple versions of forms for the same survey, tailored by type and/or level of data requested. Thus, reporting on an establishment-level survey means that a form must be filled out for each establishment. Imagine the workload for a large company with hundreds or thousands of establishments.

To get a handle on the response task and plan a response strategy, business survey respondents often review the content of the form before beginning to complete it. Since many establishment surveys require respondents to gather data from multiple sources, it is rarely possible to fill out a form from beginning to end in a single sitting.

Research questions related to these issues include:

- How could/should Web survey instruments be designed to enable reporting data for multiple forms covering multiple industries or establishments? How can the workload of direct data entry (e.g., typing) be minimized? Are there other means to facilitate data entry in an indirect manner, say by importing or "cutting and pasting" data from automated records? How would this work?

- How do respondents navigate a Web survey instrument? Would respondents prefer to be able to "preview" the entire questionnaire, navigate in a nonlinear manner, and/or "quit and resume" in order to facilitate planning of their response strategies? Since these features permit the respondent to retain control, how does this affect data quality when context may not be maintained? While it is true that paper forms also permit nonlinear navigation, should we take advantage of the ability of electronic instruments to enable survey designers to enforce some navigational controls?

- Does paper retain a role in the electronic reporting process, since paper forms may be previewed, distributed, and apportioned in a nonlinear manner more easily than an electronic questionnaire? If so, what is paper's role? Can the Web survey instrument be built to mimic the role of paper? Should it?

Edits Embedded into Web Survey Instruments

The ability to embed edit checks into data collection instruments is one of the primary benefits offered by electronic survey instruments, such as the Web, because it moves error detection and correction closer to the source of the data – that is, the respondent – for both establishment and household surveys. This feature is particularly beneficial to establishment surveys, because of the types and characteristics of data being collected. Establishment surveys typically collect numerical information – e.g., quantities, dollars, counts – and there may be theoretical or physical relationships among data items – e.g., a specific crop's harvested acres cannot be greater than its planted acres for a specific reporting unit and reference period.

Many issues related to embedded edits arise. Guidelines for designing and implementing embedded edits have emerged from usability testing and experience in production surveys (Anderson et al., 2003) that need to be substantiated by further testing. Additional research issues regarding embedded edit checks in Web and other electronic survey instruments include:

- Since a number of establishment surveys require companies to provide identically defined data items for separate, but related, reporting units – e.g., separate forms for individual establishments or industries – will respondents desire edit functionality that works across reporting unites, rather than for each reporting unit individually? How could/should edits be designed that evaluate data in this manner? Alternatively, how could/should respondents be permitted to resolve edits that fail for multiple reporting units – e.g., employment figures that fail certain types of edits across multiple establishments in a seasonal business – so that respondents aren't required to address each failure one reporting unit at a time? Since editing data separately for each reporting unit may discourage editing and/or reporting by companies responsible for multiple reporting units, could/should some analogue to "batch" processing of edits and their resolutions be designed to facilitate edit checks and error resolution in circumstances where immediate edit checks may not be optimal?

- Is it feasible – or even desirable – to transfer many or all post-collection edits to the data collection instrument? If not, what are the limiting factors? Which, if any, post-collection edit checks involving multiple variables, previously reported data or industry parameters may be incorporated into electronic and Web survey instruments? Can business respondents interpret and resolve sophisticated edits like these during data collection? If so, what information do respondents need and how should it be presented? How complex can edits become before discouraging response?

- What benefits accrue to data collection organizations by moving the edit checks and error resolution closer to the data source? Are expected data quality benefits realized? How can/should the effects on data quality be measured?

- What are the implications for data quality of survey practitioners' preferences for accepting "bad" –unresolved edit-failing – data over unit nonresponse? Under what circumstances might unit nonresponse be more acceptable from a data quality standpoint than obtaining data that contain errors?

Research Methods for Web Collection of Establishment Surveys

The context of the establishment environment not only raises substantive research questions, it also challenges traditional research and testing methods and practices. It is virtually impossible to persuade business respondents to participate in usability testing in a laboratory setting, away from their job sites. Besides, an integral part of the response process for establishment surveys involves business records, which would not be available to respondents in the laboratory.

In addition, the skewed nature of business target populations raises some conflicting needs for testing versus production data collection. Survey participation by large businesses is critical to ensuring high quality data, and, as a result, large companies are heavily burdened by being selected into many surveys. Ensuring ease of instrument use is also critical to support data collection from these large companies. While this suggests that large companies should be integral to the development and testing phases of electronic and Web surveys, it also adds to their reporting burden.

Issues related to methods used to conduct research and testing of electronic/Web survey instruments include:

- How do we conduct electronic/Web survey instrument testing with business respondents at their business locations as effectively as possible? What methods work well in this setting and which are less useful? What information is gained or sacrificed by conducting onsite testing as opposed to laboratory testing? Could researchers and remote business respondents use a screen sharing application and participate in telephone interviews to conduct usability testing of Web surveys? What are the advantages and disadvantages of this methodology? What other methods in our methodological tool kit might be useful, or how might they be modified to accommodate the remote setting?

- What can event logs and trace files tell us about respondents' use of and navigation through electronic/Web survey instruments? How should/could these data be used effectively and efficiently to inform instrument design? Might these data also be useful for survey management? Since summary and analysis of event log and trace files can often be tedious, how might Web survey software be programmed to make these data more easily accessed, summarized and analyzed?

- Since establishment survey participants tend to be heavily burdened, particularly those in large companies, how do we effectively conduct usability and other instrument testing with businesses while minimizing additional burden? What criteria

should be used for selecting cases with whom to test? What procedures can be used for piloting an electronic/Web survey in a production environment so that unit response is not jeopardized? What/how should logistical issues be addressed when piloting a Web application alongside production data collection?

Respondent Perceptions and Response Rates

Exploratory research suggests that business respondents are quite interested in reporting electronically (Hak et al., 2003; Sudman et al., 2000; Clayton and Werking, 1998); indeed it seems that they're beginning to expect it. However, research and survey production experience have shown a number of instances in which overall response rates were dampened when an electronic/Web survey option was added to the mix of reporting modes available to business respondents (Dodds, 2001). Web take-up rates, for the most part, have not fulfilled those early expectations.

A contributing factor is that the Web is typically a reporting option being added to an already existing array of alternative modes from which business respondents may choose. Since many ongoing periodic establishment surveys are based on longitudinal sample designs, business respondents often establish a reporting routine. Thus, increasing Web take-up rates requires respondents to convert to the new mode, altering their existing reporting behaviors. Recent exploratory research at the U.S. Census Bureau found that, for a short monthly survey collecting easily retrieved data, respondents found few, if any, benefits from the Web mode as compared to their current reporting routines (Hak et al., 2003). This finding led to the hypothesis that Web take-up rates may be improved in a multi-mode survey by introducing the Web option with a new survey or a new sample.

In the same exploratory research, respondents using Web applications reported preferences for this mode for seemingly subjective reasons, such as not having to move from their desks to submit the form, trusting electronic submission more than U.S. mail delivery, and entering and correcting data being "neater" than hand writing. Thus, respondents tend to perceive reductions in burden, even though some electronic functions, such as having to enter userids and passwords and react to edit checks, add steps to the reporting process.

- What constitutes respondents' perceptions of burden associated with Web reporting? Although objective burden and response tasks may be increased by the electronic mode, what features of electronic/Web survey instruments entice respondents and give them the impression of burden reduction? Can electronic/Web surveys be designed to decrease objective or task burden, and, if so, how? How is perceived burden associated with take-up rates?

- Do business survey respondents have concerns about reporting confidential, sensitive data via the Web? Do these concerns differ in a fundamental or practical manner from security concerns in household surveys? What is the nature of business survey respondents' security concerns and how can they be alleviated?

- What factors are associated with respondents' willingness to convert from other modes to electronic/Web reporting? Do changes need to be made to the instrument in order to promote mode conversion?

- Since business respondents report interest in Web surveys – some even request it – does the existence of an online reporting option, or lack thereof, affect response propensity? Does it influence respondents' opinions about government statistical agencies that sponsor or conduct the data collection? In what way? How should agencies effectively market their Web surveys to company reporters?

No doubt these research suggestions barely scratch the surface of our information needs for improving Web surveys of establishments. At a minimum, these ideas may stimulate useful dialogue and knowledge-sharing among survey researchers and practitioners developing, testing and implementing electronic/Web data collection instruments for establishment surveys.

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Section 2:

Background Papers for Workshop

An Overview of the Potential for Electronic Reporting in Census Bureau Surveys and Censuses

Elizabeth Martin, U. S. Census Bureau[1,2]

Introduction

The technological environment in which the Census Bureau conducts surveys and censuses is being transformed by the increasing availability and use of computers and the Internet in homes and businesses. This change has created new opportunities for innovations in methods and modes of collecting and distributing survey data that the Bureau began exploring over a decade ago.

The President's Management Agenda for fiscal year 2002 listed "expanded electronic government" as one of five government-wide initiatives to improve the management and performance of the federal government. The goal of this initiative is to "champion citizen-centered electronic government that will result in a major improvement in the federal government's value to the citizen."

One form this initiative might take is an expanded use of electronic reporting in data collection by the Census Bureau, and that is the focus of this paper. In keeping with the citizen-centered goal of the initiative, it *takes the respondents' point of view* to assess the current potential for expanded use of Internet and Web reporting in Census Bureau programs.

This paper summarizes some of the Census Bureau's considerable experience with Internet and other electronic modes of reporting in its business and household surveys. It evaluates evidence related to three factors which influence the feasibility and likely success of electronic reporting: respondents' access to the Internet or other means of electronic reporting, their preferences or attitudes about different modes of responding, and their behavior when offered the option to report electronically. Finally, areas where knowledge is lacking and research is needed are noted.

The cost implications or the technological requirements of expanded electronic reporting are beyond the scope of this paper. To date, research has not adequately addressed questions about

[1] This paper is reprinted here with permission from Elizabeth Martin, to inform interested parties of ongoing work and to encourage discussion of work in progress. The views expressed in this paper are those of the author and not necessarily those of the U.S. Census Bureau

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the cost, quality, and timeliness of electronic reporting. This paper addresses respondent acceptance and response rates using electronic reporting and the Internet in particular.

Evidence on Respondents' Access, Preferences, and Use of Electronic Reporting

The Census Bureau has rather recently begun to implement electronic reporting in its major population surveys and censuses. In Census 2000, it was possible to submit a census short form electronically, although the Census Bureau chose not to publicize the availability of the Internet reporting option. Given the lack of publicity, it is not surprising that very few forms were submitted this way (there were about 89,000 attempts to submit Internet questionnaires and about 66,000 valid, unique Internet forms were processed through to the census; Whitworth, 2002). Over 90 percent of a sample of Internet respondents said they were very satisfied with the Internet reporting option (Stapleton and Irwin, 2002). Preceding the census, there was also experimentation with data collection using automated speech recognition. Currently, a variety of electronic response options are contemplated for 2010 and were tested in a 2003 test (described below).

For establishment surveys, work to develop electronic reporting options dates back to the 1970s, when respondents in the Economic Census could submit their data using large tape reels. In the late 1980s, a variety of technologies were introduced and tested, including touchtone-data-entry (TDE), FAX, and diskette-based electronic questionnaires. Subsequent research has focused on Internet reporting. The 2002 Economic Census currently permits electronic reporting, and by the end of February 2.4% of all returns (and 8.1% of returns from multi-unit companies) were submitted via Internet. In the employment phase of the Census of Governments, over 10 percent are reporting electronically, most through the Internet. Other establishment surveys obtain higher rates of Internet reporting, and several surveys of governmental units are conducted entirely by Internet.

Electronic reporting doubtless would have been implemented on a larger scale, except that feasibility tests and experimental pilot studies have not encouraged its wholesale adoption.

Three limiting factors influence the feasibility of reporting by Internet and other electronic modes: access to the mode, attitudes and preferences, and respondent behavior when presented with an electronic reporting option. Evidence from both establishment and population surveys is summarized below.

1. Access

Americans' use of computers and access to Internet have grown tremendously in recent years, according to results of a periodic supplement to the Current Population Survey conducted by the Census Bureau. More than half of U. S. households (50.5 percent) reported Internet access in September 2001, up from 41.5 percent in August 2000 and 18.6 percent in October 1997 (U. S. Department of Commerce, 2002). Broad increases in access and use have occurred across all groups in the population, although the most recent survey still shows large differences by

age, education, and income. Access and use drop sharply after age 55, and at lower levels of income and education. Non-users are likely to be poor, have low levels of education, and to be Black or Hispanic (with particularly restricted access in Hispanic households where only Spanish is spoken).

Telephone surveys conducted for the Pew Internet Project find that most non-users report various reasons for not having access to or using the Internet, including expense (30%), worry about online pornography, credit card theft or fraud (43%), lack of time (29%), and the complexity of the Internet (27%). Lenhart et al. (2003) report that Internet use leveled off between 2002 and 2003, with the number of people dropping offline roughly equaling the number coming online each month.

The fact that half of households still do not have access to the Internet limits its use in surveys of the general population. Currently, it is most suitable as an option in mixed mode surveys, or in surveys of special populations with high rates of Internet coverage. However, the enormously high Internet use by children and teenagers (over 90% by teenagers in 2001; DOC 2002) implies that, over time, the population will become more uniformly fluent in its use and it potentially may become a primary rather than secondary mode of responding to surveys.

Rates of Internet access are higher for establishments than for households, but still not universal. For example, 75% of manufacturing plants reported having Internet access in a supplement to the 2000 Annual Survey of Manufacturers (U.S. Census Bureau, 2002a). Larger plants are more likely to have Internet access, which ranges from 40% of plants with 1-4 employees up to 96% of plants with over 2,500 employees. In 2000 87% of respondents in the Manufacturers' Shipments, Inventories, and Orders survey (M3) had Web access (Sedivi, Nichols, and Kanarek 2000). Governmental units and academic institutions probably have the highest rates of access, but information is unavailable.

2. Preferences

One constraint on implementation of Internet reporting is suggested by what respondents themselves tell us about their preferences for responding by Internet and other modes. In a Census 2000 evaluation conducted for another purpose[3], respondents were asked how they prefer to be enumerated in the next decennial census:

1. "Now that we have collected information about you and your household, I'd like your opinion about how we might conduct the next national Census, in 2010. In the next census, would you prefer to be contacted by mail, in person, over the telephone, or on the Internet?"

[3] The B3 study was designed to assist data users in comparing race data from Census 2000 with race data from other sources (see Bentley et al. 2003). The questions were administered in telephone or personal visit interviews conducted by the Census Bureau in about 50,000 households in August-October 2001, after respondents had returned a mail questionnaire.

2. "Which do you think would best protect the privacy of your census data? Mailing in the form, being interviewed in person, being interviewed over the telephone, or sending your information over the Internet?"

Results for both questions are shown in Table 1. All differences discussed in the text are statistically significant at $p < .05$.

Table 1. Mode Preferences for the 2010 Census

Mode	Percent prefer to be contacted this way	Which mode best protects privacy?
Total	100.0%	100.0%
Mail	66.7% (.91)	65.2% (.93)
Personal visit	7.9% (.52)	16.3% (.72)
Telephone	10.0% (.57)	10.7% (.61)
Internet	15.4% (.70)	7.8% (.52)

Source: B3 survey. Standard errors (shown in parentheses) were calculated using stratified jackknife methods in VPLX.

Clearly, mail is the dominant mode, preferred by two thirds of survey respondents (and perceived as the most private by about the same fraction). Internet is second most often preferred, telephone third, and personal visit least often preferred.[4]

The second column of the table shows that, when respondents are asked which mode best protects their privacy, personal visit gains adherents and Internet loses them. Less than half of the people who preferred Internet perceived it as the mode that would best protect the privacy of their data. (This result is not shown.) These results are consistent with other evidence that the Internet raises more concerns about privacy and confidentiality than other modes. For example, about half of respondents in a 2001 survey said they were more concerned about

[4] Similar results were found in a 1999 NORC survey conducted mostly (84%) by telephone and by mail, with no preceding mail questionnaire. When asked how they preferred to be interviewed, 69% preferred to fill out a questionnaire themselves, 18% preferred telephone, and 6% preferred an interviewer to visit them at home (Brittingham et al., 1999). (Internet was not an option.)

providing personal information over the Internet than over the telephone, with about 8 percent less concerned and 41 percent equally concerned (DOC 2002).

Concerns about loss of control of information are at the heart of many peoples' concerns about providing information over the Internet, according to ethnographic interviews conducted by Gerber (2003).

Demographic correlates of response mode preferences may provide guidance about which population groups are likely to be most responsive to an Internet reporting option. Charts 1-5 (attached) show mode preferences by gender, age, income, education, and English language ability. Mail is preferred among almost all groups[5], but the extent of the preference varies, as do preferences among other modes. (In part, preferences reflect access, since a respondent who does not have access to it is unlikely to prefer being contacted by Internet.)

Males are more likely to prefer Internet and less likely to prefer mail than females, as shown in Chart 1 (even though their access is equal; DOC 2002). Preference for Internet declines and preference for mail increases the older a respondent is, although a negative association between Internet preference and age doesn't emerge strongly except in respondents 50 and older (Chart 2). People with higher levels of education and/or income are much more likely to prefer Internet and somewhat less likely to prefer mail than people with less education or income (see Charts 3 and 4), consistent with patterns of access. The modes that involve some contact with a person—personal visit and telephone—are more popular among people with lower education or income than among more educated or affluent people. This likely reflects their concerns about the difficulties of filling out a form on their own, leading to a desire to have an enumerator help them. A preference for personal modes (especially telephone) over self-administered modes shows up even more starkly among people who speak a language other than English at home and do not speak English very well (this information was collected in census long forms and merged with results of the survey). As shown in Chart 5, preference for Internet drops out completely for people who do not speak English at all, and preference for mail declines drastically.

These survey results are consistent with Gerber's (2003) ethnographic study of privacy attitudes. She found that more affluent respondents prefer mail and the Internet because these modes allow them to stay in control of their time and living space. However, the poorest respondents prefer face to face interviews, because "they like to be able to assess an interviewer in person, in order to be able to decide if [he/she] is trustworthy. They have, perhaps, more confidence in their ability to read individuals than to determine if written promises of confidentiality are dependable. In addition, some respondents see the interviewer as a source of explanations of difficult material and a possible helper if giving the information proves somehow damaging" (2003:21).

[5] Response by mail is preferred even among people who are the most favorably disposed to Internet. For example, 53 percent of males with bachelor's or advanced degrees making $70,000 or more a year prefer mail compared to 41 percent who prefer Internet.

In assessing the potential for Internet responding, it is of some interest to examine the mode preferences of people who in Census 2000 failed to respond by mail and were therefore enumerated in the nonresponse followup operation. Their preferences, shown in Table 2,

Table 2. Mode Preferences Among Census 2000 Mail Respondents and Nonrespondents

Preferred Mode	Responded by mail in Census 2000	Did not respond by mail in Census 2000
Total	100.0%	100.0%
Mail	70.5%	55.7%
	(1.07)	(2.11)
Personal visit	6.2%	12.9%
	(.57)	(1.42)
Phone	8.1%	15.1%
	(.63)	(1.54)
Internet	15.1%	16.4%
	(.85)	(1.55)

Source: B3 survey.

provide some indication of whether an Internet option might improve response rates among mail nonrespondents.

Perhaps not surprisingly, people who failed to respond by mail in the last census are much less likely than mail respondents to prefer being enumerated by mail in the next one. However, most still prefer mail. Mail nonrespondents were more likely to prefer personal visit or telephone enumeration than mail respondents. Interestingly, the two groups were equally likely to say they prefer Internet. Thus, we conclude that an Internet option might succeed in reducing the follow-up workload among the 16% of mail nonrespondents (representing almost 7.3 million people) who say they prefer it.

3. Respondent Behavior

Information about how respondents actually behave when electronic reporting is available comes from a great deal of research and testing conducted by the Census Bureau. Internet and other electronic response modes have been implemented for different purposes in different survey designs. Rarely is Internet the sole mode of responding to a survey. More often, it is offered as an alternative mode of response that respondents may choose at an initial contact or during nonresponse followup. Sometimes it is offered as a means of conducting follow-on surveys or panel surveys, with respondents switching to Internet after initial interviews in another mode. The sections that follow summarize research on these applications in establishment and population surveys. The focus here is on the response rate implications,

since that question is so fundamental to their implementation, but many other issues are addressed in these studies. Several conclusions emerge:

- Offering an electronic option does affect respondent behavior, with more respondents responding by Web or Internet when encouraged to do so.
- In most tests to date, offering an Internet option has *not* improved overall response rates, and sometimes is associated with *lower* response rates.
- Available evidence suggests that Internet surveys have the advantage of speed, and can be completed quicker than traditional modes of response.
- The effects of Internet reporting on data quality are unclear, although anecdotal evidence suggests it may lead to improvements; research is needed to address this issue.

Internet or Other Electronic Mode as the Only Mode of Response

Most surveys that rely exclusively on electronic reporting cover special populations with very high rates of Internet access, such as university faculty (Schaefer and Dillman, 1998) or government employees. Couper, Blair, and Triplett (1999) experimentally compared e-mail and mail modes in an organizational climate survey of employees of federal statistical agencies conducted in 1997. E-mail produced significantly *lower* response rates, probably in part due to technical difficulties affecting access. Bates (2001) compared Internet and mail reporting in a organizational assessment survey of Census Bureau employees conducted in Fall 2000. The Internet had a significantly *higher* response rate (66.6% compared to 62.8% for mail) and response was faster (6 versus 13 days, on average), but item nonresponse rates were higher in the Internet returns.

One unusual application of a Web-based survey of the general population was conducted by Knowledge Networks in partnership with the Census Bureau during Census 2000. A series of 5 cross-sectional surveys was conducted between March 3 and April 13, 2000, by Knowledge Networks under the sponsorship of private foundations (Nie and Junn, 2000; Martin 2001). Households were recruited using an RDD sample of household telephone numbers in areas with access to the Web TV network. Those agreeing to participate (57% did so) were provided free hardware and Internet access, allowing surveys to be self-administered using a Web browser and to include multimedia content. The Census Bureau participated as a partner in the project in order to gain experience with Web surveys and obtain immediate feedback on public reactions to the census. Results were available within a week of fielding and the Director of the Census Bureau made extensive use of them in communications with stakeholders and testimony before Congress. An important limitation was the low cumulative response rate of about 30%, taking into account recruitment success and survey response. This is much lower than the Census Bureau would accept in its own surveys. The characteristics of respondents corresponded fairly closely to population data from the Current Population Survey, except that individuals with less than a high school education were under-represented .

Currently, Web-based surveys of the general population are not adequate as a basis for statistical estimates, but do provide a useful method for monitoring short-term trends in attitudes and awareness and providing immediate feedback about public reactions to current

events. It is important for users to be cognizant of the likely coverage and nonresponse biases that may affect such surveys (see Couper 2000).

On the establishment side, an experimental test of an Internet-only option was conducted in a short supplement to the 1999 Annual Survey of Manufacturers about e-business (Dodds 2001). One half of the sample received a letter containing the URL and directing that the survey be

completed over the Internet. The letter also explained that a form would be mailed to those who did not report over the Internet. The other half sample received the customary mailing package containing a paper questionnaire as well as the URL. There were mail follow-ups (including a paper questionnaire and a URL) to nonrespondents in both panels. The Internet-only panel obtained a significantly *lower* response rate of 79.5%, compared to 84.4% in the mail + URL panel. About 39% responded by Internet (rather than paper) in the Internet-only panel, compared to about 9% in the mail + URL panel.

A number of Census Bureau surveys of governmental and educational institutions are successfully conducted entirely by Internet. For example, the Academic Libraries Survey permits only Internet response, and obtains an 88 percent response rate.

Internet as an Alternative Mode that a Respondent Might Choose in an Initial Contact

During Census 2000, the Response Mode and Incentive Experiment (RMIE) was conducted to examine the effects of offering one of three alternative modes of responding (Internet, call in for a computer-assisted telephone interview, or call in to an interactive voice response system or IVR) in addition to the option of mailing back a census short form questionnaire (Westat, 2002). For a random half of households, an incentive (a calling card) was offered to respondents who used the designated mode. The incentive was associated with a lower overall response rate, but it did induce respondents to choose the proffered mode in greater numbers. In the absence of an incentive, the panels offering Internet or reverse-CATI had slightly but significantly *higher* overall response rates (by about 2 percentage points) than the mail-only control. Respondents who were offered the Internet option but instead returned mail questionnaires gave as reasons the greater ease of completing the paper form, concern about privacy, or their lack of access or knowledge of the Internet. Data quality was highest on reverse-CATI, second highest on the Internet, third on mail forms, and lowest in the IVR.

In 2003, a National Census Test offered IVR and/or Internet as alternatives to mailing back a paper census questionnaire (Stapleton, Brady, and Bouffard, 2003). Three separate experimental treatments offered choices between paper and IVR, paper and Internet, or paper, Internet, and IVR. (A paper replacement questionnaire was mailed to nonrespondents in all three panels.) The three treatments obtained about the same cooperation rates as the control treatment (paper initial and replacement questionnaires). About 90 percent of respondents who were offered a choice responded on paper, and the remainder by Internet or IVR.

Data were returned much more quickly using the electronic modes. A week after the initial mailing, 40 percent of Internet forms and 23 percent of IVR returns had been received, compared with 10 percent of paper questionnaires.

This study also experimented with "pushing" respondents toward electronic responding, by not offering a paper option in the initial mailing. (Paper replacement questionnaires were mailed to nonrespondents, however.) The "push" treatments succeeded in obtaining more electronic responses (about two-thirds of responses were electronic) but also obtained significantly lower overall cooperation rates.

Another experiment offering Internet as an alternative to mail response was conducted for the American Community Survey (Griffin, Fischer, and Morgan, 2001). For a random half of households, the envelope and the long form questionnaire informed respondents of the Internet option, and a card with instructions on how to respond by Internet was added to the mailing package. In this experiment, offering the Internet option significantly *lowered* the response rate by nearly 6 percentage points. The authors suggested that privacy concerns and frustration with the Internet instrument may explain some of the effect. They hypothesized that offering a mode of response other than mail in conjunction with a mailing package contributed to a break in the response process.

An experiment involving an establishment survey was conducted in a 1999-2000 mail survey of libraries in elementary and secondary schools (Nichols, Marquis, and Hoffman, 2001). A random sample of cases received information about the benefits of responding by Web, which was printed on the questionnaire and on a special insert, and the other half did not. (All sample cases received information about Web access in the initial mailing.) Respondents who were encouraged to respond by Web were more likely to do so (21 percent, compared to 9 percent in the control panel). However, this study too saw a suppressed response rate in the treatment that encouraged Web reporting (a 36% initial response rate compared to 45% for the control) which was only overcome through extensive telephone followup. The authors note that four additional tasks were required to respond by Web, adding burden and perhaps explaining the low initial response.

Another experiment was conducted in the Private School Survey, which is conducted by mail with CATI and field follow up of nonrespondents. Three approaches to improving Internet response (and thereby reducing follow up costs) were tested in the 2001-2002 survey. In one, mail and Internet were offered concurrently; in a second, an invitation to respond by Internet was offered, with a mention that a paper questionnaire would be sent soon; and in a third, an invitation to respond by Internet was offered with no mention of a paper questionnaire (although one was later sent). Initial response rates were significantly higher in the second and third experimental treatments, but final response rates did not vary significantly among the treatments or the mail control. The fraction responding by Internet varied from 11% in the first to 19% in the third experimental treatment.

A non-experimental study tested the feasibility of moving establishment respondents to specific modes of electronic reporting in a monthly economic indicator survey, the Manufacturers' Shipments, Inventories, and Orders survey (M3) (Anderson et al. 2003). Respondents were called and asked to switch from fax reporting to either TDE (touchtone/speech recognition) or Web. About 80 percent agreed to try TDE or Web, but

fewer than half actually did so. Follow up contacts revealed that submission by fax was generally much easier and more convenient than either of the other modes, especially TDE. Although most respondents preferred fax and resisted changing to another mode, those who could be persuaded to try Web reporting liked it (even though it was slightly more burdensome) and intended to continue reporting in that mode. No evaluation of the mode switching attempt on overall response rates was done.

Export statistics (excluding exports of merchandise to Canada) are received by the Census Bureau on paper forms or electronically through its Automated Export System (AES). In 2001, 85 percent of the export transactions were received electronically, and the increase in electronic reporting is associated with improved data quality. Prior to AES, an average of 27 percent of all export transactions contained reporting errors, but this has declined to 17 percent as more filers have opted to use the AES. About 56 percent of export records captured on paper contain errors, compared to 20 percent of records received and pre-edited electronically (U. S. Census Bureau, 2002b).

Finally, the Quarterly Financial Report is based on data collected from manufacturing, mining, and trade corporations electronically and on paper. A diskette containing a computer self-administered questionnaire (CSAQ) is sent to respondents, who can then respond by transmitting it by Internet, by sending a disk, or by a paper form. Most respondents mail or fax back a paper form (which can be downloaded from the Website) with 28 percent using the CSAQ to respond. There is evidence that the CSAQ obtains better data, as indicated by fewer items changed by the analysts (Evans, 2003).

As an Alternative Mode in Nonresponse Followup – A second component of the response mode experiment conducted in Census 2000 (RMIE, described above) offered an Internet option to households that had failed to respond to the initial mailing. A follow up letter offered one of three modes, and again, a random half was offered a calling card incentive to respond in the designated mode. In the absence of an incentive, computer-assisted telephone interviewing elicited the highest response from mail nonrespondents (6.7%) followed by interactive voice response (3.4%) and Internet (3.4%) (Casper and Shaw, 2003). None of these modes achieved the approximately 10 percentage point increase typically obtained by mailing a replacement questionnaire (Dillman, Sinclair, and Clark 1993), although all resulted in significant response improvements over the initial contact by mail.

As a Mode of Responding in Subsequent Waves of a Longitudinal Panel Survey or in a Follow-on Survey. – Another possible use of Internet reporting is in interviews after the initial one in a panel survey. A test of the feasibility of an Internet option in a complex demographic survey was conducted in conjunction with the Methods Panel Survey of Income and Program Participation (Griffin and Holbert 2001). Eligible households (those with at least one college graduate) were pre-screened to determine their ability and willingness to respond by Internet. Only 17% reported Internet access; of those, 61% were willing to complete an on-line survey, but only 22% of those who said they were willing actually completed the survey. About half of nonrespondents had attempted to access the survey but did not complete it due to lack of time or difficulty logging in and other technical problems. Over half of nonrespondents said they preferred mail surveys, followed by a third who preferred on-line surveys and 6 percent

who preferred telephone or personal visit. Both Internet respondents and nonrespondents expressed concerns about the security of data transmissions.

Similar negative results were obtained initially with a similar pre-screening procedure in a business survey, the Computer Organization Survey, which in 1998 obtained a response rate of 27 percent of the respondents who had expressed ability and willingness to respond by Internet.

At the time, stringent security requirements severely restricted what browsers could be used. When the browser constraints were relaxed, the 1999 COS Internet response rate jumped to 74% of those willing and able to respond by Internet (Sedivi, Nichols, and Kanarek, 2000).

Conclusions

The research on Internet reporting in establishment and household surveys appears to support broadly similar conclusions in both types of surveys. This suggests that knowledge gained in one may shed light on problems in the other, and that researchers should communicate findings across these two areas.

Several general conclusions emerge from the research to date on electronic reporting options in Census Bureau establishment and household surveys and censuses.

- Internet access is high and increasing in the population at large, but is by no means universal. People with lowest access to Internet tend to be less educated and poor.
- Internet access is higher in economic establishments than in households, but still not universal. It may be highest in governmental units and educational institutions.
- Exclusive reliance on Internet reporting is rarely an acceptable option. Internet cannot replace personal visit and telephone interviewing in most Census Bureau surveys and censuses. The exception would be surveys of groups with very high Internet coverage.
- The Internet is second only to mail as the preferred mode of responding to the decennial census. The Internet appears to raise more privacy concerns than other modes; more research on this topic is needed.
- Respondents can be pushed to report electronically in greater numbers by e.g., offering incentives or restricting their choice of mode (esp., taking away the preferred paper option). The cost is likely to be a drop in overall response rates.
- Internet reporting has promise when offered as a choice in either an initial contact or in nonresponse followup in mixed-mode designs. However, pilot tests and experiments do not show the response rate improvements that might have been hoped for, and in fact more often show declines than increases in response rates in research to date.
- Using Internet to administer a follow-on survey among respondents pre-screened for their willingness and ability to access the survey by Internet has not worked very well in Census Bureau studies to date.
- Internet, and to a lesser extent IVR, appear to increase the speed of response compared to mail or traditional modes.

Several factors in addition to access appear to be influencing the results of tests to date. Respondent preferences for simple and convenient modes appear to be a powerful constraint on implementation. In the decennial census, the dominant preference for mail helps explain why people persisted in filling out mail forms even when offered other options. Yet, a substantial minority claims to prefer Internet, and it ought to be possible to translate this preference into response improvements. Although less information is available about establishment respondents' preferences, research suggests many also strongly prefer the simple modes of fax and mail, at least in short surveys.

Intuitively, one might expect that offering an additional mode of responding can only help respondents, and improve response. Clearly, this is not the case. Tests to date suggest it is possible to do serious harm to response rates in survey designs that offer electronic reporting options. In other cases, there are slight improvements or no effects when respondents are offered a choice to report electronically. The surprisingly variable effects of an Internet option on overall response rates lead to the conclusion that the details of implementation need very careful design attention and usability and field testing prior to implementation.

Perhaps not surprisingly, early tests of Internet reporting were often plagued with technical difficulties and usability problems that affected respondents' ability to receive, complete, and return electronic surveys. (Such problems may account for adverse effects on response rates in some studies reviewed here.) Performance is likely to improve as user interfaces are improved through continuing usability research and improvements in technology. (For discussion of research on usability conducted by the Census Bureau, see, e.g., Murphy et al. 2001.)

One factor that should be considered in evaluating results to date is that respondent acceptance appears to increase with experience. Respondents often need to be trained to report electronically. This suggests that the performance of electronic reporting is likely to improve over time, and that surveys with repeated contacts with the same respondents may have more to gain from implementing it than one-time surveys.

Research is needed to learn how offering an Internet option affects the response process. Several possibilities exist, such as:

- Adding text and instructions may increase the (perceived or actual) complexity of a mailing package.
- Responding by Internet may add steps to the response process, hence increase burden.
- Offering an alternative response mode may in effect add a task (choosing a response mode) to the response process, which if difficult may inhibit some from responding at all.
- In both household and establishment surveys, Internet reporting appears to raise more privacy concerns than other modes, and these need to be better understood.
- Anecdotes and some evidence suggests that electronic reporting may reduce errors and post-collection editing, but more systematic evaluation is needed to better understand the effects on data quality.

These and other issues need careful attention in laboratory studies, debriefing interviews after a survey is completed, or field experiments.

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Chart 1. Mode Preference, by Gender

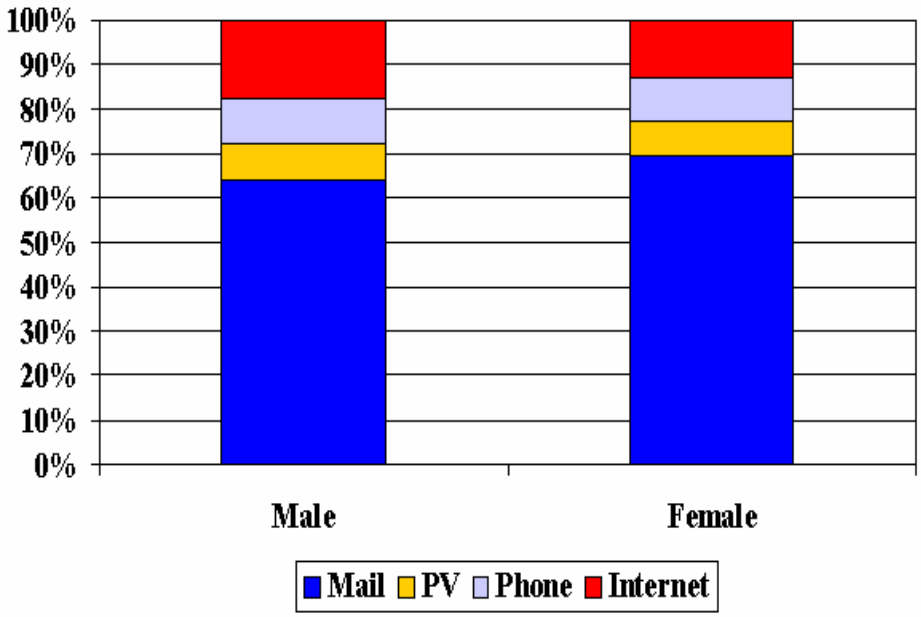


Chart 2. Mode Preference, by Age

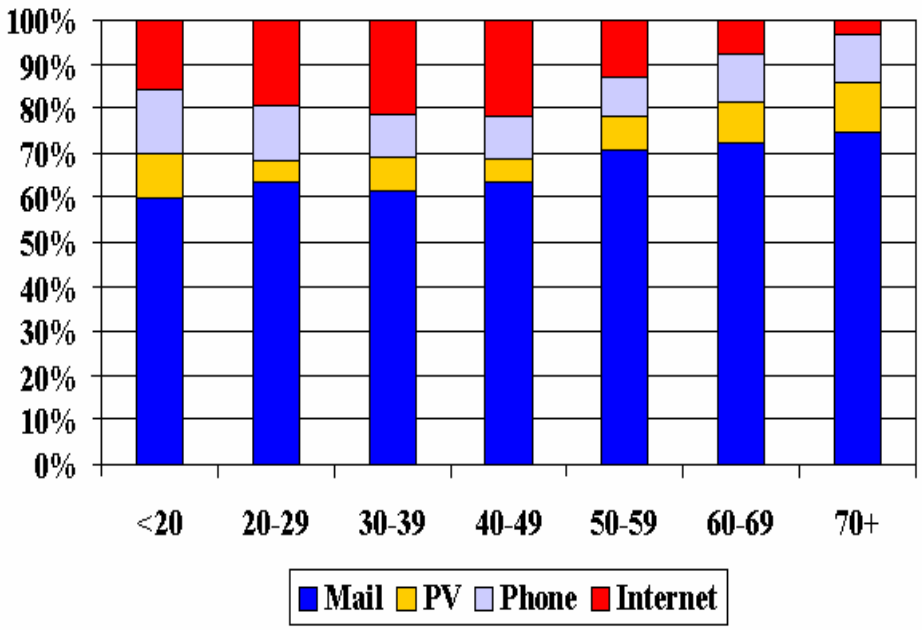


Chart 3. Mode Preference, by Income

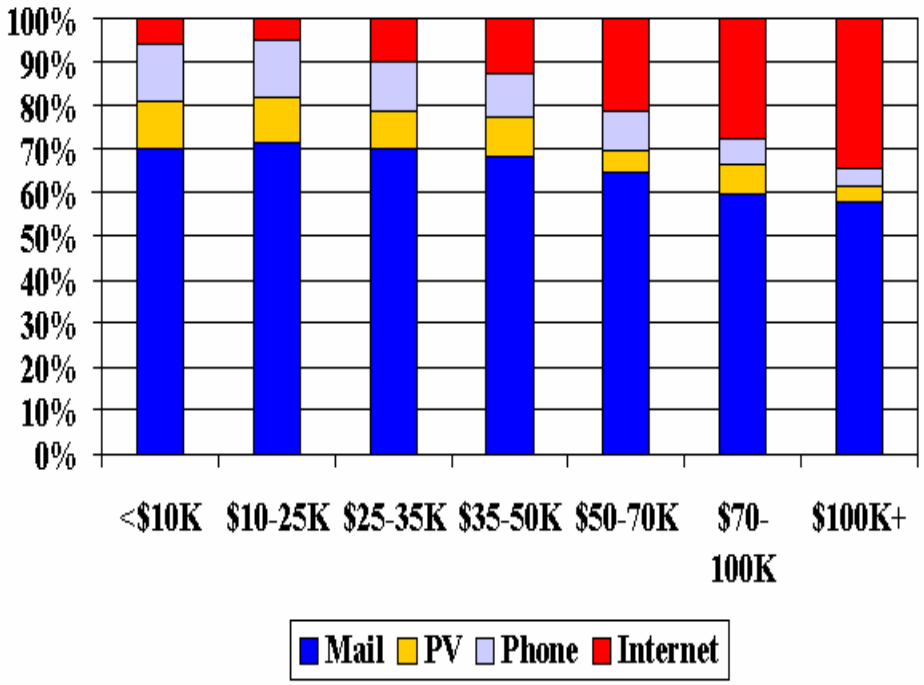


Chart 4. Mode Preference, by Education

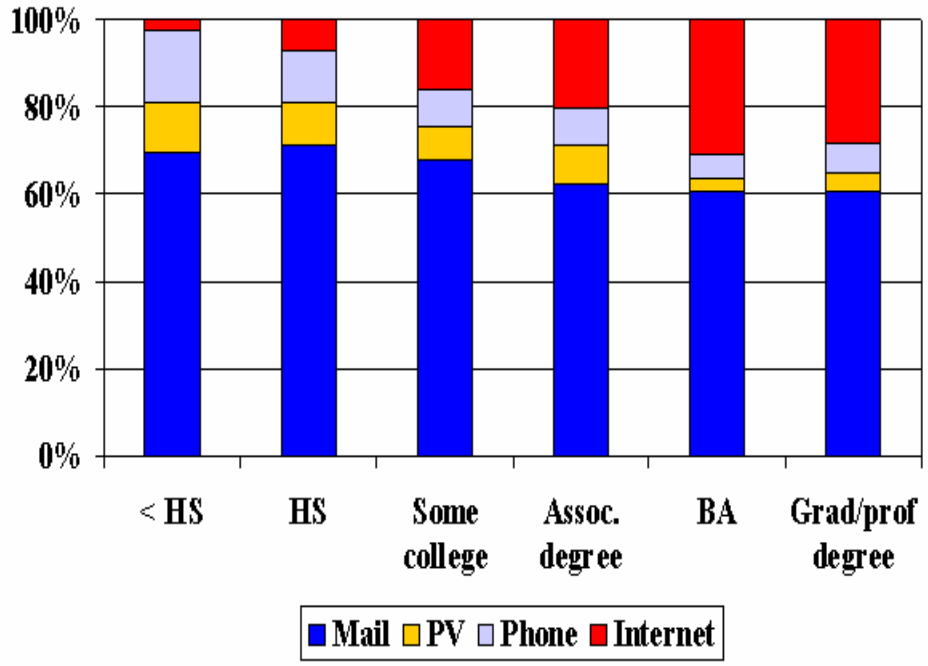
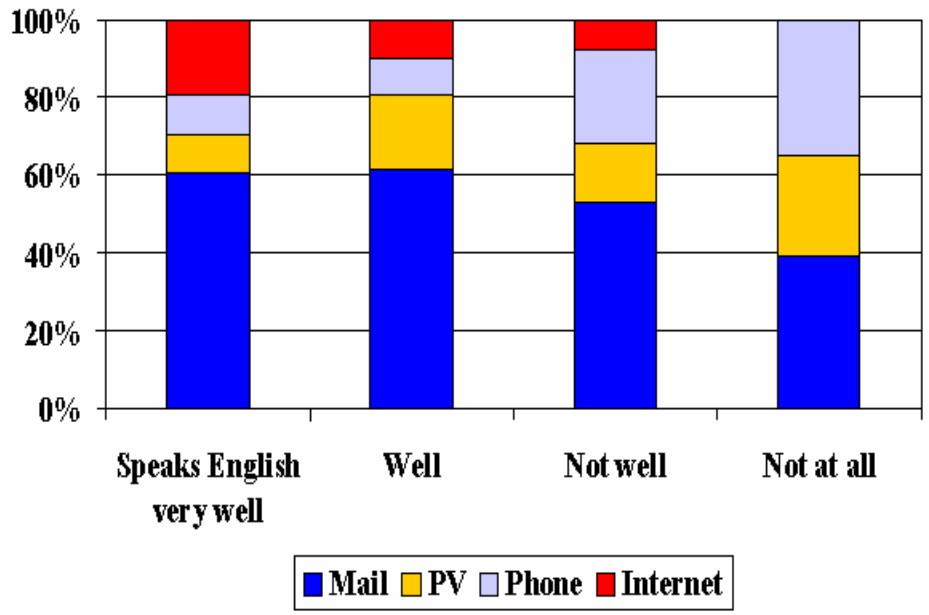


Chart 5. Mode Preference among Non-English Speakers, by English Language Ability



Usability Issues Associated with Converting Establishment Surveys to Web-Based Data Collection

Jean E. Fox
William Mockovak
Sylvia K. Fisher
Christine Rho

Office of Survey Methods Research, Bureau of Labor Statistics

1. Introduction

In an effort to combat non-response, survey managers continually seek new ways to encourage respondents to participate in their surveys. One approach is to offer respondents the option of selecting from multiple reporting modes so that they can select the mode they prefer. The Internet is one of the newest modes available and offers a variety of benefits. For example, respondents can access the Internet easily from their desktop PCs, so they can complete the survey at their convenience. Properly designed surveys can introduce instructions, edits, and help screens that simplify the respondents' task by guiding them through the completion process. From a survey manager's point of view, the Internet eliminates or reduces data entry costs, because respondents enter data themselves. Further, Web surveys can check data as the respondent works, so the need for follow-up phone calls or post-data collection processes is minimized. With these obvious benefits, the Internet offers the potential for enhancing response rates, improving data quality, and improving timeliness of reporting. In addition, the potential for cost savings also exists, although in some cases offering an additional data collection mode might actually increase costs.

On the other hand, there are some possible drawbacks to Web data collection. One major problem is that the use of multiple data-collection modes complicates data integration and survey operations, such as follow-up efforts. Further, developing Web surveys can actually raise up-front costs. The cost of building, maintaining, and integrating different systems is expensive. Moreover, preliminary research with Web surveys indicates that rather than enhancing response rates, offering multiple modes can actually depress overall response rates (Griffin et al. 2001). For a detailed discussion of these and other problems, see Fricker and Schonlau (2002).

In establishment surveys, the Internet is likely to be one of several reporting options that may include mail, phone, and fax. While respondents may select another reporting mode if a Web survey is too difficult to complete, they may also decide not to report at all. Further, since respondents often participate in more than one government survey, a respondent may generalize from a negative experience on one Web survey to others, even though different agencies may be involved. Therefore, to encourage participation, survey managers need to design Web surveys that will provide as positive an experience as possible for the widest range of respondents. A key element of that design is ensuring the usability of Web surveys.

This paper focuses on the usability of dedicated Web-based government surveys, where usability is defined as the effectiveness, efficiency, and satisfaction experienced by respondents as they provide the requested survey data. At BLS, we are dedicated to developing usable Web surveys. This paper describes our experiences and lessons learned in designing Web surveys for establishments.

2. Usability Issues in Web Survey Design

As with any new technology, early attempts to develop Web surveys have relied largely on existing conventions for Web design, coupled with research on designing surveys for other modes, and the personal preferences of designers. This heuristic approach is understandable, because research regarding the design of large government Web-based surveys is still limited. However, after some experience at BLS, we have identified several important issues related to the usability of Web surveys. Following are some of the design considerations and constraints that we believe federal survey managers should be aware of when considering the use of Web-based surveys.

2.1 Importance of Standardization across Surveys

Many government agencies conduct numerous establishment surveys, which means that in some cases, the same establishment (and respondent) responds to more than one survey. From a respondent's perspective, it is logical to expect that the look and feel of all Web surveys from the same agency will be similar. To accommodate respondents and allow for adequate security, the Bureau of Labor Statistics offers a common portal or gateway into its data collection Website, called the "Internet Data Collection Facility" (IDCF).

In addition to a common gateway, the IDCF requires that all surveys meet internal standards for user interfaces.[6] One of the challenges of applying these standards was that the early adopters (i.e., surveys introducing Web collection first) were designing their Web survey as the standards were being developed. Therefore, these survey managers had the extra responsibility of providing input to determine appropriate standards. On the other hand, later adopters were faced with some established standards that were not quite appropriate for their purposes. Once standards are in place, they are often difficult and costly to change. At BLS, we are just beginning the process of reviewing our standards. We expect that support for changes will come from research, from respondents, and from requests made by survey managers using Web-based data collection.

2.2 Consistency across Survey Data-Collection Modes

Research has found that different modes of data collection for identical content can produce different results (e.g., Dillman, 2000; Dillman et al., in press). As noted by Couper[7], design of Web surveys is important because they are self-administered, interactive, visual, potentially multimedia, and are distributed over a wide variety of hardware and software systems. This

[6] *GUI and HTML Standards.* Internal Bureau of Labor Statistics document.
[7] Workbook for JPSM seminar in Web Survey Design, February 18-19, 2003.

last characteristic is especially important because the most carefully laid out design can appear quite different depending on the respondent's hardware and software configurations.

Therefore, if a survey uses multiple data collection modes, survey managers need to ensure that comparable data are being collected using the different modes. Since federal establishment surveys deal largely with reports of factual information, some survey managers may discount research findings on multi-modal differences, because these studies have dealt primarily with attitude questions or question formats not typically used in establishment surveys. However, caution is warranted. Assuming that different data collection modes do not affect the reporting or accuracy of establishment data may be a questionable hypothesis until the necessary research is done.

2.2.1 Creating a Unique Design for the Web vs. Reproducing the Paper Form – Some survey managers make the immediate assumption that the best Web design when converting a paper form to the Web is one that simply adopts an electronic copy of the paper form already in use. The argument for this approach is that respondents who are already familiar with the paper form will transfer their knowledge of the paper form to the Web version of the form and, therefore, have little difficulty completing the Web version. Also, it may be tempting to believe that using an electronic copy of the paper form will result in similar data collection results across all collection modes. However, as mentioned above, the representation of the form may be affected by the respondent's hardware and software configurations. At a minimum, a computer screen and a piece of paper are very different types of displays and may require different types of behaviors from the respondent.

The "direct copy" approach would seem to work best when the form is fairly simple, it can be displayed with little or no scrolling, and screen display concerns have been addressed. Surveys that are longer and more complex often need a different interface for the Web version to avoid usability concerns. These surveys can also take advantage of automated skip patterns and edits to streamline the respondent's effort.
Another concern is that the direct copy approach may discourage Web reporting. If respondents are completing exactly the same form, they might wonder why they should expend the additional effort necessary to enter data on a computer, which requires the additional step of signing or logging on.

Since the Web and paper are two different modes, they each have their own advantages, which should be exploited. For example, paper allows more of the survey to appear on a single page, and affords more flexibility in layout and formatting. The Web allows you to walk respondents through the process using automated skip patterns, exposing them only to the relevant parts of the survey, and also providing validation checks, where appropriate. Our experience at BLS has been that program managers prefer to start with the "direct copy" approach, but then once they see the actual product, readily make the transition to designs that take better advantage of the computer.

2.3 Security and Confidentiality on the Web

Our gateway requires identical log-on procedures for all surveys, but two security options are offered: (1) Personal ID Number (PIN) and password or (2) digital certificate. A digital certificate offers a higher degree of security, but is somewhat complicated for respondents to obtain. Initially, digital certificates were confusing to users, but after usability testing and a change of vendors, the process was simplified substantially.

Although easier to use, the PIN & password approach also presents possible difficulties. The log-on information must be sent to respondents, which, in itself, presents some security concerns. Existing security requirements also demand the creation of a fairly complicated permanent password (it must meet multiple criteria) that many users are not used to, and which many find confusing. Finally, respondents must be able to recall permanent passwords for future access to the system. To help minimize confusion with temporary passwords, we have found that it helps to provide passwords that do not contain 0 (zero) or o (oh), or 1 (one), l (el), or I (eye), as they may be difficult to differentiate.

Although necessary to protect respondents' confidentiality, Web security procedures introduce an additional hurdle compared to other response modes. In addition to increasing respondent burden, the net impact of security procedures associated with Web reporting is that these gateway functions will increase operational demands on the surveys and require a larger support or help staff. For example, Web reporting for the Current Employment Statistics survey generates 'trouble tickets' from about 15 percent of the sample each month, versus about 4 percent for the long-established touchtone data entry help desk.[8]

2.4 Validation Checks

Obviously, paper forms lack any type of validation checks or edits. Therefore, one might assume that any editing done in a Web form would automatically result in improved data quality, as well as save money by reducing the number of follow-up phone calls. On the other hand, a delicate balance exists between the survey designer's need for the highest possible data quality and the burden imposed on a respondent when trying to respond to edits. If the scale tips too far, the overuse or improper use of edits could lead to frustration, increased burden, and either possible premature exits from the survey or refusals to report in the future. What is important to keep in mind is that edits are critical to the overall design and should not be viewed an afterthought to be dealt with as a last step in the design process.

Although the use of some edits may seem perfectly justified, another issue concerns their enforceability. Surveys use both hard and soft edits to distinguish between required and recommended changes. If a *hard* edit is triggered, respondents must address the problem to continue. On the other hand, if a *soft* edit is triggered, respondents are notified that there may be a problem, but they are not required to make any changes. A related question regarding edits in Web surveys is when they should be used. Possibilities include (1) immediately after an entry is made, (2) after a table (grid) of entries is completed, (3) after a complete screen of

[8] Personal communication with Richard Rosen, Program Manager for the Current Employment Statistics program.

entries, or (4) at the very end of a survey, when the respondent submits the data. Each option imposes different demands on the respondent.

Edits can be implemented in several different ways. For example, the edit message could appear in a separate window (pop-up box), as text next to the entry field, or on a separate page. A common problem when edit messages are displayed on the same screen is that respondents may fail to see them, even when different color text is used. When this happens, respondents think they either failed to click a button properly or that the same screen has redisplayed in error, so they simply click *Continue* again. In general, it is usually better to let respondents know about problems or potential problems as soon as possible. However, some edits can only be run when respondents indicate that they are finished, such as checks for consistent data across multiple entries.

Because there is a lack of research that addresses the general issues of how and when to use survey edits, there is no ideal solution at this time. However, some general guidelines may be helpful. For example, to be useful, edits must be noticed, read, understood, and then acted upon. Moreover, they cannot be overly burdensome. With these common sense goals in mind, the following general design guidelines are proposed:

- Take steps to ensure that edit messages are noticed (e.g., through good screen design).
- Use plain English (avoid jargon), and keep the explanatory message as brief as possible.
- Give control to users. Allow them to either change the answer or leave it as is, and to move on when ready.
- Consider offering a comment box, so the respondent can explain the entry.
- Err on the side of introducing too few edits into the initial Web survey. Study the resulting data and then gradually introduce edits into future releases to see if data quality issues are addressed.

Admittedly, these are rough guidelines, but until definitive research is done, they provide a useful starting point.

2.5 Navigating Among Survey Questions

Any Web application requires some basic level of navigation. An important point to keep in mind is that respondents do not approach the task of completing a Web survey with the same expectations elicited by other on-line tasks, such as ordering merchandise or searching for information about a topic, tasks which people do because they want to (Schober, Conrad, Ehlen, and Fricker, 2003). Numerous observations in usability tests indicate that when respondents encounter a survey question or survey form, they expect a structured task, where a question is posed and they provide an answer.

Respondents also approach tasks with behaviors and expectations acquired from previous experience on the Web. For example, they are likely to do things like use the Back button on the browser, click X to close the application, click on underlined words for additional information, or try to tab among multiple answer fields. Moreover, many respondents will know how to use radio buttons and check boxes for choosing answers. Therefore, a Web survey designer must expect that respondents are likely to engage in expected, conventional behaviors when completing a Web survey. If the interface responds differently, then respondent confusion is likely, which could lead to error.

In terms of navigating a survey questionnaire or form, at a minimum the respondent should be able to move from one question or answer field to another, either automatically (cursor is controlled by the survey) or with the use of a mouse or tab key; leave (exit) or be able to close the survey before it is completed and return to the same point; back up to a previously answered question, and either review or change the answer; access question-specific help and return to the same point in the survey; and access a survey home page from within the survey as a navigational anchor.

2.6 Section 508 Requirements

A critical issue in the development of government Web surveys is the need to meet Section 508 requirements. Section 508 is a federal law that requires electronic and information technology (including Web sites) that are developed, procured, maintained or used by the federal government to be accessible to people with disabilities. This law also applies to self-administered, Web-based surveys, where a major concern is the accessibility by visually challenged respondents. Some of the most important guidelines are the following:[9]

- images must have equivalent ALT text (text assigned to a graphic, which screen readers can interpret)
- color and stylesheets must not be mandatory to view the site,
- data tables must be properly coded with headers,
- frames should be named properly,
- alternatives must be provided for scripting languages,
- if plug-ins are used, a link to the download page must be included,
- forms should be coded properly and logically, and
- repetitive navigation should be coded so that it can be skipped.

2.7 Other Screen Design Principles and Issues

There are a variety of other screen design issues that affect the usability of Web surveys. Although there are many sources of guidelines for designing Web applications, very few focus on surveys. Dillman and Bowker (2001) is one of the few sources that specifically address

[9] See http://www.Webaim.org/standards/508/checklist for a Section 508 checklist.

Web surveys. They propose 14 principles for guiding Web survey design and addressing four major sources of survey error.

Unfortunately, many issues specific to Web surveys have not yet been resolved. For example, designers of federal surveys may face the following questions:

- Which is better, a page-by-page approach or a single scrolling page?
- Which labels should be used for navigation buttons (e.g., "Submit" vs "Save" vs "Continue")?
- What is the optimal way to present on-screen instructions or validation checks?
- How should "help" functions be presented?

At present, the best we can do for many of these questions is to follow general Web design practices. Sources for helpful information include the *Research-Based Web Design and Usability Guidelines* (available online at www.usability.gov), *Shaping Web Usability* by Albert N. Badre (2002), and *Designing Web Usability* by Jakob Nielsen. Other useful sources include Nielsen and Tahir (2002), Spool, Scanlon, Snyder, DeAngelo, and Schroeder (1998). There are many other good books on designing and building Web pages as well. We have included some general Web design guidelines relevant to Web surveys in Appendix A.

3. Incorporating Usability into Your Development Culture

Many large survey development projects follow the "waterfall lifecycle," where one stage of development follows the previous, with little or no feedback to repair problems in earlier stages (Royce, 1970). For example the development team would (1) prepare the specifications, (2) design the survey and associated database, (3) build the system and program the survey, (4) test it, and (5) deploy it. Fraser (2002) adds that in newer incarnations of the waterfall model, the development team would have a contractor conduct a usability test just before deployment to ensure that user requirements were met. If you follow this approach, you will probably find that the resulting survey may still contain numerous usability problems, potentially leading to inaccurate data or non-response.

Boehm (1988) noted that the waterfall lifecycle model is inflexible and risky. He found that the cost of making changes increases exponentially from one stage to the next, and, the likelihood of having major problems is very high because there are few opportunities to fix problems as they occur. Fraser (2002) added that the waterfall approach to usability testing leads to a poor user interface and reliance on outsiders. Since production schedules will often not permit major changes late in development, a common strategy using the waterfall approach is to make the easy, more cosmetic changes in the current release, but to save the major changes for the next release. Unfortunately, this list often grows rapidly as users find more and more problems.

In response, Boehm (1988) created the "Spiral" lifecycle model. In this model, development starts small, at the "center of the circle." Each cycle around the center consists of analysis, development, and testing. Each cycle, or iteration, includes more and more functionality,

building on previous iterations. This method not only helps developers find problems earlier, but also makes it possible to incorporate feedback from users before development is nearly final.

One process often utilized as a way to focus on the users is known as *user-centered design* (Norman and Draper, 1986). Within BLS, survey programs are strongly encouraged to

implement a user-centered design approach (Fox, 2001; Mockovak and Fox, 2002). Simply defined, this process ensures that the needs of the users are incorporated into the design of the software from the beginning and throughout the design process. User-center design activities can be easily incorporated into the development, testing, and feedback cycles of the spiral model.

Gould (1988) lays out four principles for designing usable systems:

(1) Early and continual focus on users
(2) Integrated design (coordinate work on all components)
(3) Early and continual user testing
(4) Iterative Design.

It is important that the user-centered design activities be led by those who are skilled and experienced in the field of usability. They have to know (1) which methods are appropriate at each stage of development, specifically within a particular development schedule, (2) how to implement the methods, (3) how to interpret the results, and (4) how to present the results to the development team and management. Although the methods themselves may seem straightforward, these four challenges highlight the specialized skills that are required. For example, Nielsen and Molich (1990) created the "Heuristic Evaluation" as a method that could be applied by developers knowledgeable about the product but not necessarily about usability. Nielsen (1992) later found that the method was most successful when conducted by usability specialists.

Incorporating a user-centered design approach does not have to be expensive. It is always possible to incorporate some level of effort within the expected development schedule. When the effort is made early on, it can prevent expensive problems later in development.

Usability testing is one of the most common tools of user-centered design. Ultimately, it is highly desirable to test actual users, but users with roughly comparable characteristics will suffice in early stages of the testing. Moreover, in most situations it is not necessary to test a large number of users. For example, Virzi (1992) argues that five users will often be satisfactory, with diminishing returns from testing additional users. Members of the development team should observe the usability test, so that they can see firsthand the types of difficulties that users are encountering.

The frequency of usability testing depends on the application being built. At BLS, we generally test Web surveys every 2-3 months or so, giving developers the time to incorporate

design changes. As Gould (1988) suggests, we have also found that it is critical to test all parts of the system. Therefore, we also evaluate advance mailings, instructional brochures, or e-mails, since they will directly impact use of the system and the users' experiences.

4. Summary

To make effective use of the Web for conducting surveys, survey managers must address a variety of issues, many of which are currently unresolved. This paper summarizes key issues that survey managers should be aware of when they design new surveys for Web collection or convert existing surveys. At BLS, we have found that a process called *user-centered design* is extremely helpful to ensure that Web surveys are easy for respondents to use. This paper provides some basic suggestions for incorporating a user-centered design approach into the development of government surveys.

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Appendix A

These are some general Web design guidelines that may be useful to those designing Web surveys for federal agencies.

Basic Web Guidelines

- Be consistent within the Web site.
- Use standard interface controls as they are supposed to be used (e.g., radio buttons for "Check one" and check boxes for "Check all that apply").
- Use a simple URL that people can remember.
- Limit requirements on User names and passwords to keep them simple; avoid 1 (one), i (eye), and l (el), as well as 0 (zero) and O (big oh) and o (little oh). However, your agency may have specific security requirements you must follow.
- Consider how the page will print out. Some respondents may print it, fill it out, then transcribe the data.
- Provide information on privacy, confidentiality, and ADA issues.
- Provide links to sites that show how your "products" (i.e., data) might be useful to the respondent.
- Provide easy access to help (e.g., an email address or phone number).

Navigation

- Make it obvious what respondents should do next.
- Label links clearly so respondents understand them.
- Make it easy to correct mistakes.

Layout

- Put important information at the top, left-hand side of the page.
- Limit the use of graphics (minimizes download time and helps meet Section 508 requirements).
- Do not use animation, unless it helps the respondents.
- Eliminate horizontal scrolling.
- Minimize vertical scrolling where possible.

Data Entry

- Use appropriate data entry tools (e.g., radio buttons vs. check boxes).
- Make text boxes large enough to accommodate the longest possible response (use scrolling on very long fields).
- Drop-down lists can be helpful in limiting the responses to valid values. However, some responses may be "hidden" if respondents don't scroll the list.
- Label each data entry field clearly.
- Don't make respondents enter data twice (e.g., birthdate and age) unless you are using it to verify a value.

- If respondents need responses from one question to answer another, display the questions together.

Text

- Use short, simple sentences and paragraphs.
- Avoid jargon and acronyms, unless they are very familiar to the respondents.
- Use well-designed headings to guide the respondents.
- Use a sans serif font, as the serifs don't display well.
- Don't make the lines of text too long, as it's hard to find your place when going from one line to the next.

Color

- Use high contrast colors (e.g., black text on a white background).
- Use color coding appropriately and consistently, without overusing color.
- Do not rely on color coding as the only way to convey information.

Editing by Respondents and Data Suppliers

Orietta Luzi, Italian National Statistical Institute[1]
Natalie Shlomo, Israel Census Bureau of Statistics [2]

Abstract: This paper contains an analytic summary of the content of the session *Editing by respondents and data suppliers* of the UN/ECE Work Session on Statistical Data Editing (SDE) held at INE, Madrid in October 2003. The aim of the session was to collect information about recent trends at Statistical Agencies to change their traditional view on editing as a post-data collection phase under the complete control of survey methodologists to preventing and eliminating errors by moving some of the editing processes directly onto the respondents and data suppliers. The session focused on aspects relating to the integration and optimisation of the editing in the data collection phase taking into consideration the overall respondent burden, and the harmonisation of editing processes performed at both the data capturing and data editing stages by balancing expected levels of quality, time and available resources. The session also covered aspects relating to editing when administrative or external sources of data are used for statistical purposes. Based on the papers presented at the session, a new "mixed" perspective is emerging where editing and imputation is spread over the entire survey process. This paper summarizes and discusses from theoretical, operational and methodological points of view the main aspects and problems presented in the various papers of the session. In particular, this paper concentrates on the following aspects: evaluating the editing effectiveness when editing activities are spread over different survey phases; managing survey processes when more than one source of information (statistical or administative) is used for statistical purposes; rationalizing survey processes when different modes of data collection are combined; improving cooperation with data providers.

Key words: editing and imputation, electronic data collection, external and administrative data, mixed editing strategies.

1. Introduction

In Official Statistics, critical quality dimensions are the accuracy of final data and the processing costs. The definition of accuracy mainly depends on the particular survey objectives, while costs are generally defined in terms of timeliness, resources spent during the survey process and the burden on respondents. Since accuracy and costs are strictly related, one of the most crucial problems of Statistical Agencies is to find the balance between them. This optimal point is not unique, but depends on the survey characteristics and available resources.

[1] Orietta Luzi, ISTAT- Italian National Statistical Institute, Via Cesare Balbo 16, 00184 Roma, Italy, luzi@istat.it
[2] Natalie Shlomo, Israel Central Bureau of Statistics, Kanfey Nesharim 66, 95464 Jerusalem, Israel, natalies@cbs.gov.il

It is well known that the editing and imputation process (E&I) is one of the most time and resources consuming survey phases, in which residual non-sampling errors from other survey phases are dealt with. When a non-effective E&I strategy is adopted, well known problems arise such as over-editing, high respondent burden due to re-contacts, increase of editing time, higher costs, risk of introducing new errors in the data and low data accuracy.

For editing to be cost and quality effective, attention has to be paid to its rationalization during the overall survey process (Granquist, 1995). This can be done, for example, by preventing errors from arising (e.g. by improving the questionnaire design and by moving editing closer to data collection), by targeting editing resources at significant errors, by eliminating unnecessary editing and by monitoring statistical effects and costs of editing in order to identify possible inefficiencies.

In recent years, Statistical Agencies have progressively changed their traditional view on editing as a post-data collection phase where, under the complete control of survey methodologists, the data collected, coded and entered in previous survey phases are checked and validated to produce coherent and complete data. In order to reduce high costs and improve timeliness of the surveys, Statistical Agencies have concentrated their editing efforts on preventing and eliminating errors altogether. This is carried out in two main directions:

- moving editing to the early stages of the survey process, i.e. to the data capture phase, making the respondents part of the data verification process, and thus increasing the accuracy and timeliness of collected data;

- exploiting as much as possible available external and administrative information, thus reducing respondent burden and high costs by eliminating the need for surveys to collect information that is already available in electronic databases (either statistical or not).

Concerning to the first point, the continuous progress in the area of Information Technology (IT) and increasing use of computers and Internet has stimulated the use of electronic data transmission and computer aided modes of data collection. With regard to the second point, the availability of a high amount of information in external electronic databases encouraged Statistical Agencies to increase the use of these archives for their statistical purposes.

As a result of methodological, technological and operational advancements, and the need to increase accuracy under low response rates, high costs and time requirements, both the traditional survey process and the usual post-data collection view on editing have been progressively replaced by a new "mixed perspective". The editing processes consist more and more of an integrated set of activities (not always under the control of the statistician), spread over the whole survey process, that are to be harmonized together. In this new perspective, data providers are increasingly involved in the survey process not only as a source of information, but also because of their data verification capability. This capability needs to be exploited as much as possible for improving data accuracy, timeliness and lowering costs while maintaining

high cooperation levels. Multiple data collection strategies are usually adopted, in which different modes of data capture are used depending on the respondent's characteristics and technological capabilities, and the nature of the surveyed information. Furthermore, data collected for different purposes (statistical, administrative, or other purposes) are increasingly used to fulfill specific survey objectives.

To discuss the complex E&I strategies where mixed modes of data collection are adopted and where part of the editing activities either are not under the Statistical Agency's control (as for administrative data), or are directly performed by respondents or data suppliers (as in Web surveys or computer aided data collection), the session *Editing by respondents and data suppliers* has been organized for the UN/ECE Work Session on Statistical Data Editing (SDE) held at INE, Madrid in October 2003 (see http://www.unece.org/stats/documents/2003.10.sde.htm for further information).

In preparing for the session, papers were solicited discussing the problem of managing, improving and evaluating the editing effectiveness when editing activities are spread over different survey phases and data providers have a role in the data verification process. The session involved aspects of rationalizing and improving the effectiveness of editing, as well as fulfilling quality requirements when either administrative data or information from external sources are used in statistical survey processes.

In general, presentations made at the session dealt with different aspects and problems of designing complex statistical processes and integrating editing strategies when different sources of information (either statistical or administrative) and/or different modes of data collection (both traditional and electronic) are combined. Contributions highlighted new methodological and operational challenges and described specific experiences and solutions adopted at Statistical Agencies in this area. The main goals of Statistical Agencies when building their overall data collection and editing strategies are to encourage data suppliers to perform editing and checks on their own data, to improve the quality of their own editing strategies, to accurately document their editing activities, and to optimize data accuracy and survey costs by rationalizing available resources.

Two main sub-topics were identified for the session: *editing strategies when editing is anticipated at the data collection stage* and *editing strategies when external and administrative data are used in the statistical survey process*. The overall organization of the session and the discussion afterwards revolved around these two sub-topics.

Concerning the sub-topic of designing editing strategies for the data collection stage, different alternatives are adopted in current surveys. Computer Aided Interviews (CAI) contain built-in editing rules that are incorporated into the data capturing instrument so that the interviewer is notified of a response that fails one or more edits during the interview. Computerized self-administered questionnaires delivered to respondents by mailing disks or CD-ROMs, or electronically transmitted over the Internet's World Wide Web shift part of the editing activities to the respondents.

In relation to the sub-topic of designing editing strategies when external and administrative data are used in the statistical survey process, Statistical Agencies are progressively using more external sources of information to fulfill as much of the statistical requirements as possible while reducing response burden and minimizing costs. In order to make external data useful for statistical purposes, Statistical Agencies have to analyze the benefits and drawbacks of the data and develop methodologies for the logical checks and edits, and for identifying and correcting messy data. Different approaches can be adopted for the E&I of external and administrative data depending on the objectives and the use of the data which include: building registers, censuses and frames; incorporating administrative and external data to produce statistical target indicators in surveys; using administrative and external data to enhance and improve editing processes of survey data.

Obvious advantages of this new survey organization are the reduction of most of the drawbacks affecting traditional survey processes. On the other hand, the design of editing strategies has become a more complex task and it depends on the specific survey characteristics and objectives. In particular, Statistical Agencies have to face some critical points such as:

- high initial costs for integrating new sources of data/new technologies in survey processes;
- managing and improving cooperation with data suppliers;
- integrating information, concepts and definitions from different sources (statistical, administrative, other);
- revising information needs and quality requirements in order to adapt them to data providers characteristics, technological and editing capabilities;
- designing complex mixed survey/editing strategies in which different data collection modes/data editing approaches are to be integrated in an efficient and coherent way;
- allocating resources for editing throughout the survey processes;
- balancing quality dimensions such as timeliness, costs, accuracy and response burden.

This paper discusses, for each above mentioned sub-topic, specific aspects and problems from theoretical, operational and methodological points of view. Discussion points and issues raised in presentations and in the open discussion at the 2003 SDE Work Session are highlighted and analyzed. The paper is structured as follows. Section 2 discusses designing editing strategies when editing is anticipated at the data collection stage through computer assisted or other IT approaches to data capturing. The Section 3 analyzes designing editing strategies when external and administrative data are used in the statistical survey process. In both sections, the relevant points and issues that were elaborated in the presented papers as well as the general discussion at the work session itself are reflected. Concluding remarks, open problems and future research can be found in Section 4.

2. Editing Strategies When Editing is Anticipated at the Data Collection Phase

Experience shows that preventing errors is preferable to correcting them in the editing phase. In the design and planning phase of a survey, a researcher can take steps to ensure that the

question-answer process proceeds as accurately as possible, thus avoiding errors and improving data quality. Despite these efforts, errors generally occur in data entry, coding and editing phases, due to the following sources: the mode of data collection, the questionnaire, the respondent, the interviewer, and the data processing (De Leeuw et al., 2003). Some of these factors can be better controlled through the use of computer-assisted modes of data collection and integrated systems for survey processing, where part of data editing is anticipated at the data capture stage.

The impressive developments of Information Technology (IT), the increasing use of Internet, the growing availability of electronic data on both individuals and businesses, are all factors encouraging Statistical Agencies to exploit as much as possible the use of IT-based approaches to data collection. Two main modes of electronic data collection can be identified:

- Computer Self-administered Questionnaires (CSAQ) via Web or other forms of electronic data transmission (downloadable software, e-mail attachments, diskette/CD electronic forms);

- Computer Aided Interviews (CAI): Computer Aided Telephone Interviews (CATI) or Computer Aided Personal Interviews (CAPI), Computer Aided Self-administered Interviews (CASI).

The recognized main advantages relating to the use of IT modes of data capturing are:

- reducing non-response by increasing cooperation and offering benefits to data providers;
- reducing organizational costs (questionnaire delivery, coding, data entry, data editing);
- improving data quality and timeliness, reducing respondents burden.

Under given survey conditions (type of electronic tools, characteristics of respondents, the questionnaire, information required and confidentiality guarantees), CAI and CSAQ generally result in less item non-response than paper-and-pencil surveys. Using these approaches allows the optimisation of the effectiveness of both data capturing and survey process. Timely information from data suppliers (persons, enterprises, private agencies or public administrations) is obtained with higher guarantees on data quality and lower response burden. Furthermore, survey costs due to delivering, coding and entering questionnaires are eliminated. Time and costs of post-data collection editing activities are reduced due to preventing typical errors at the data capturing stage, such as routing errors, range errors and some types of inconsistencies.

Various implementations suggest solutions to designing integrated editing strategies when different modes of data collection are combined in a survey process, and data suppliers participate in the data verification activities at the data capturing stage. Focusing on the editing area, the following ones highlight the advantages and new problems derived from adopting this sort of mixed approach:

- National Statistical Institute of Spain (INE) uses Total Quality Management as a method to improve production processes and to obtain higher quality output, while using electronic

data delivery via Web (Revilla et. al., 2003). Enterprises are considered part of the statistical production process both as data providers and data users; therefore they are to be directly involved in the data verification process at the data collection stage. Efforts are being made to improve the dialogue between Statistical Agencies and respondents, in order to improve cooperation and data quality.

- The Federal Statistical Office of Germany tackled the problem of optimizing the overall data quality by adopting the so-called "plausibility improving measures" at the data collection stage (Wein, 2003). These measures include the use of electronic tools (Internet, IT, CAI), and the adoption of an "outsourcing" philosophy: making data providers perform part of the editing on their own data, in order to efficiently capture and check data at the collection stage. Depending on the origin of the data, two approaches of data retrieval are used: the traditional processes in which data collection is largely under the control of statisticians, and the new survey processes that capture data from external sources which are collected without the control of statisticians.

- The US Bureau of Labor Statistics (BLS) uses different modes of electronic data collection (self-administered questionnaires and Web-based tools) depending on the survey's purposes and the characteristics of respondents. An effort is made to provide respondents with the most appropriate option for submitting their data. Readers interested can find an analytic description of the editing strategies adopted for BLS surveys where Web-based data collection is implemented (Cohen, 2003).

- The US Energy Information Administration (EIA) also performs data editing at the data capturing stage via electronic methods such as Web surveys, downloadable software and e-mail attachments. Most of the 65 surveys conducted by the EIA are business surveys. Editing strategies are implemented, in the EIA, at both the data capturing and the traditional editing stages. Readers may be interested to read a review of the development of Web-based questionnaires and to an analytic discussion about advantages and drawbacks of the different modes of electronic data collection (Weir, 2003).

- The US Bureau of Economic Analysis (BEA) achieved progress in converting paper-based collection modes to electronic modes over the Internet, for example in collecting data on American direct investments abroad and foreign direct investments in the United States, on the financial structure and operations of parents and affiliates and on balance of payments transactions between parents and affiliates (Walker, 2003). The Automated Survey Transmission and Retrieval System (ASTAR), used by the BEA, has facilities for ensuring data security and confidentiality as well as an import facility allowing respondents to link directly to their accounting systems to improve timeliness and quality of the data transmission process.

From all experiences it can be concluded that the extent and the type of editing performed at the data entry stage depends on five main elements (Weir, 2003):

- the sophistication of the electronic option selected,

- the amount of available development resources,
- the required quality of the data,

- the acceptable respondent burden,
- the required security of the transmission.

The use of computer-assisted techniques and other electronic modes of data collection and transmission have a technological impact. It concerns, first of all, identification of the most suitable technique (CATI, CAPI, Internet, etc.) for the specific type of respondents and their technological capabilities, the required information, and the survey targets and constraints in terms of time and costs. It is well known that costs related to traditional paper-and-pencil mode of data collection (e.g. questionnaire reproduction, mailing, data coding, data entry) can be considerably reduced, and the timeliness of data transmission and further data processing can be increased when using the IT approach to data collection. In the EU context, for example, timeliness has become a crucial element because of regulations imposed to Member Countries to provide both preliminary and final results by predefined deadlines. Statistical Agencies are concentrating efforts towards the design of survey processes using IT data capturing methods and electronic questionnaires. Particularly for Web-based data collection with self-administered questionnaires, high resources and time are required to develop, test and implement the IT data collection process, to redesign the overall survey process and adopt an editing strategy where respondents are directly responsible for data checks.

The use of electronic modes of data collection is changing the way Statistical Agencies build their statistical survey processes, with an increasing need to develop methodologies and strategies for adapting traditional processes to the new technological context and to the increasing demand for high quality information. The main problems for Statistical Agencies are not only defining and obtaining the minimum level of quality for electronically provided data, but also integrating the use of IT in traditional survey and data treatment processes. Integrating the use of electronic/CAI approaches in data processing implies an overall redesign of the survey in a *quality assurance* context, i.e. developing editing strategies where timeliness, costs, quality requirements and respondent burden are properly balanced. Finding this balance requires an accurate design not only of the electronic questionnaire, but also of the edits to be used throughout the computer-assisted data collection. This concerns, for example, the type of edits (either logical or statistical, either hard or soft depending on whether respondents can skip incoherent situations, etc.), and the amount of rules to be prioritized at the data capturing phase in order to prevent the most critical errors on the most relevant items while preserving timeliness and the cooperation level. These elements all must be defined taking into account the survey objectives and the nature of investigated variables.

Other critical aspects that deserve further consideration:

- need of increasing the cooperation between questionnaire developers and editing methodologists for optimizing the overall questionnaire design; editing methodologists should be involved in any pre-testing and post-testing of the questionnaire (Weir, 2003);

- need of collecting information during the data processing through the use of metadata to further improve questionnaires and editing strategies and to prevent errors in next survey repetitions.

These aspects are strictly related to controlling and reducing the overall respondent burden and increasing the cooperation level and response rates. Statistical Agencies have to make maximum effort in designing electronic questionnaires that are efficient in terms of the type and amount of questionnaire items, structure of the questionnaire, adopted classifications, definitions and wording of questions, in order to simplify the data capturing process. In addition, questionnaires should be adapted as much as possible to the technological and informational capabilities of data providers (for example, allowing businesses to capture electronic information directly from their own databases). Questionnaires should be tailored depending on the type of respondent (private citizens, businesses, private agencies) and the type of information required (economic information, sensitive information like health or social attitudes, etc.). Important elements for increasing the cooperation level and reducing non-response can be implemented through some more technical aspects: providing options and help facilities for respondents (e.g. information from previous schedules, help systems, automatic calculations, etc.); designing and managing appropriate error messages and information to data suppliers, especially for complex edit-failure feedback information; determining how to present edits and the optimal timing of when to perform them (e.g., while filling out the questionnaire or just before the questionnaire is submitted), simplifying the task of making corrections (Cohen, 2003). In order to improve cooperation with data suppliers and their availability to edit their own data, the connection between the use of incentives, response rates and data quality has to be further investigated (Revilla, et al., 2003).

A typical problem in the case of electronic data capturing, and in particular Web-based questionnaires, relates to data security and confidentiality. User concerns about confidentiality, privacy and data security could have an impact on response rates. In general, it is not easy to assess what is the relation between the level of security and confidentiality and the level of cooperation. Aspects relating to this point are discussed in Weir (2003).

A growing tendency at Statistical Agencies consists in developing more complex strategies to increase data quality and response rates by using multiple questionnaires and different modes of data collection for sub-groups of respondents having different characteristics and technological capabilities. The resulting *mixed* approach implies an increasing complexity in terms of designing, harmonizing and managing the overall information flow, as well as rationalizing the available resources on the whole survey process.

3. Editing Strategies When External and Administrative Data Are Used in the Statistical Process

Due to technological advancements in recent years and the development of sophisticated modes of data collection based on IT, Statistical Agencies are making efforts to collect data from external and administrative sources to fulfill some of their requirements for statistical data. The use of accurate and coherent external and administrative data can reduce the scope and even replace some of the surveys needed for statistical target indicators, thus reducing respondent burden and costs while increasing the quality and timeliness of the data. In many business surveys carried out by Statistical Agencies, the data collected on smaller enterprises are based entirely on administrative sources such as Tax Authority Files. This allows more resources to be used for collecting survey data on the larger enterprises and dealing with non-

respondents. New regulations for member countries of the EU with respect to having comparable data and uniform definitions and classifications at an international level have also increased the need and awareness of using available external and administrative data. In addition, external and administrative data can be used for increasing the quality of data, such as identifying coverage errors in existing frames and registers and improving the E&I processes for missing or erroneous survey data.

External and administrative data are never automatically ready for use in the statistical process since they are collected for different purposes. Classifications and definitions of variables are often inconsistent with the needs of the statistical agency and data suppliers are not necessarily responsible for the quality specifications that meet the requirements of the statistical agency. Usually, the data must undergo extensive editing and preparation before incorporating them into the statistical process. Data suppliers have different organizational and technological capabilities, thus making the data collection of external and administrative data a complex processing system. Resources are needed to develop new methodologies for the collection and preparation of the external and administrative data, for measuring the accuracy and possible biases that may be introduced into the data, for statistical modeling to compensate for missing data, and to develop effective and efficient E&I processes when using multiple sources of both survey and administrative data.

The goal is to fulfill as much of the statistical requirements as possible for external and administrative data at the point when the data is collected (Laaksonen, et al., 2003). Thus it is necessary to increase cooperation and interaction with data suppliers and get them to conform to the quality requirements of the statistical agency and perform editing on their own data. Incentives can be provided to data suppliers to get them to perform edit checks and increase the quality of their own data. One form of incentive is to improve interaction and feedback and provide assistance to data suppliers with new and innovative software and methodologies for statistical editing, imputation and modeling.

Statistical Agencies are gaining experiences with using external and administrative sources of information for statistical purposes either separately or in combination with survey data, as demonstrated by the following examples:

- Statistics Finland uses multi-level and longitudinal registers including the central population register, businesses, taxation authorities, employer and pensioner organizations and others (Laaksonen, et al. 2003). In addition, administrative data in the business area are used for efficiently developing and updating business registers. A method of profiling is undertaken where external information is integrated into the statistical process in order to identify enterprises, their legal and operating structure and production units. Due to increasing cooperation with data suppliers and their availability for improving their own editing practices, the data verification process is an interactive and integral part of the editing strategies at the agency.

- Statistics Sweden is using administrative tax data to estimate economic indicators produced by the Swedish Structural Business Statistics (Erikson, 2003). Statistical modelling is

  undertaken to compensate for gaps on particular indicators or on target population subsets. The focus is on preparing the administrative data for use in the statistical process, choosing the most appropriate source with regard to quality, the level of detail, the similarities of the definitions and concepts, and the level of coverage. The Agency also uses its administrative data to quantify frame errors and specifically to check for under and over coverage problems particularly crucial in business statistics.

- The US National Center for Health Statistics also aims at moving editing as close as possible to data providers during the data capture stage or very near to that stage (Harris, 2003). Their method is called the "source point data editing". Different approaches to data collection and the control on data quality for the various surveys carried out at the Agency depend on the type of information asked (sensitive questions such as attitudes, illnesses or social behaviours or demographical questions such as births and deaths), whether the respondent is an individual or another agency, and the respondent's technological capabilities. Editing strategies are often combined and harmonized especially for mixed modes of data collection and the different sources of information flowing into the survey process.

- Statistics Belgium (Vekeman, 2003) uses administrative data to compensate for non-response in the Belgian Structural Business Statistics. Information from Profit and Loss accounts is used to recover missing information on accounting totals, then a breakdown of these totals are imputed using methods that exploit as much as possible the observed correlations between accounting totals and the missing total details. Two methods for imputing missing information on accounting totals are being compared in a trial: temporal extrapolation (ratio estimation on data of the same responding unit from a previous survey) and the use of additional collective data (ratio estimation on grossed up data of similar respondents with respect to known auxiliary information). The results of a comparative evaluation study showed that if previous data are available, the temporal extrapolation gives better results because it exploits temporal correlations in the breakdown of accounting totals for each given company. The second technique imputes the mean ratio within each homogeneous group, consequently its performance depends on the amount of available auxiliary information that can be used to define groups.

The focus of editing strategies when external and administrative data are used is on finding the trade off between the gain in productivity and ensuring quality. How to find this balance depends on the type of data suppliers, the type of information they collect, the type of quality controls performed, the adopted statistical definitions and classifications, the coherence and quality criteria, and the quality of record linkage between different sources of data. External and administrative data need to be adapted to the statistical process and integrated with other sources of information, especially when the goals are to investigate coverage errors in frames and registers, and to harmonize and standardize of statistical classifications for producing statistical target indicators. The challenge is to be able to link the information coming from different sources, to identify the missing information, and to assess the quality and adapt appropriate E&I methods to make external and administrative data usable for statistical purposes. Obtaining as much knowledge as possible on the sources of data directly from the

data suppliers, the checks and edits carried out by data suppliers as well as their definitions and classifications, form the basis for the successful integration of external and administrative data in the statistical processes at the statistical agency. Data with low quality can be utilized efficiently when combined with other sources of information through the use of statistical modeling and imputation (Erikson, 2003).

Increasing cooperation with data suppliers for changing/updating the type and amount of data checks is an important factor for integrating external data sources. Data suppliers are not necessarily responsible for data quality from its statistical point of view. They usually have a different conception of data with respect to accuracy and content, and are not obliged to modify their data processing procedures. Statistical Agencies generally have more demanding targets for data quality than those of the data suppliers, and this fact influences the type and amount of editing activities that is performed on external and administrative data at the agency. The quality requirements depend on the target variables, type of edits applied, and the detail of the editing. The complexity of the editing activities increases as the differences among purposes, definitions of units and variables, concepts, and classifications increase. Experience shows that external data suppliers generally provide the statistical agency with all information needed for their editing and analysis activities, and sometimes provide more variables than is minimally needed to allow the statistical agency to exploit as much information as possible. In general, data suppliers are available for reviewing their own data if the statistical agency is not satisfied with the quality of some subsets of data. The cooperation and the interaction with the data supplier with regard to making the data supplier part of the data verification process is one of the most important factors for obtaining high quality external and administrative data.

The E&I procedures on external and administrative data have similar characteristics and pose similar problems as those developed for traditional survey data. An efficient editing system should guarantee higher data accuracy and lower costs. Internal inconsistencies, missing, invalid and extreme values potentially influent on target indicators are looked for among the data. The use of electronic data capturing of external and administrative data allows incorporating rigorous checks at the point of data capture, and data suppliers can be re-contacted within a limited time following the data collection. In addition, appropriate edits need to be defined for incorporating different sources of external and administrative data with

survey data. The goal is to select the values of variables that ensure that no inconsistencies occur in the data and that guarantee high accuracy and data quality. Manual review may be performed on critical units while in some experiences smaller units can be imputed automatically. A balance must be found between automatic and manual editing with respect to costs, quality and timeliness. A simple procedure for imputation on external and administrative data described in papers may be based on the average values of the variables in homogeneous groupings (for example, groupings defined by activity code and size when using administrative tax data to impute data for businesses). A validation of target indicators after the E&I process is necessary.

The crucial points for a successful E&I strategy on external and administrative data are:

- defining the amplitude of acceptance bounds for both ratio and query edits in order to find the balance between how much editing to perform and the required level of data accuracy;
- balancing between the amount of manual editing and automatic imputation through the rationalisation of resources, reduction of time, costs and respondent burden;
- identifying the appropriate type and amount of edits to be used taking into account the statistical quality requirements and the available resources;
- balancing between the desired level of accuracy of final data and accuracy of manual data review;
- identifying the most appropriate imputation model for the different missing patterns, exploiting as much as possible all available information.

Methodologies for statistical modeling to integrate all available information required to derive statistical target indicators need to be developed. This implies initial high survey costs for the extensive editing and quality checks on the external and administrative data and moving resources to research. However, the costs are balanced by the increase in data quality and timeliness and the decrease of respondent burden and other costs for carrying out surveys. This is especially true in recent years when survey data suffers from a high level of non-response thus lowering the quality of the survey data. New types of biases that may occur in the statistical data when incorporating external and administrative data into the survey process need to be assessed. These are, for example, errors in the record linkage process between different sources of external data, inconsistencies in the sources of data and compensating for missing values for specific indicators or sub-populations. Being dependent on external and administrative data, the statistical agency needs to continuously adapt its practices to external data changes, to classifications and definitions used by data suppliers, and to increase the interaction and cooperation with data suppliers for setting up better editing practices and detecting erroneous data.

4. Conclusions and Future Research

The main sub-topics that evolved from the session *Editing by respondents and data suppliers* at the 2003 UN/ECE Work Session on SDE were the following: managing, improving and

evaluating the editing effectiveness when editing activities are spread over the different survey phases; managing survey processes when more than one source of information (either statistical or administrative) is used for statistical purposes; rationalizing and improving the effectiveness of survey processes when different modes of data collection are combined together; cooperating with data providers who have an important role in the editing and data verification processes.

Conclusions and future areas for research on *editing strategies when editing is anticipated at the data collection stage* are summarized in the following points.

- Using IT modes of data collection implies the need to take into account in the data collection strategy the information and quality needs, the survey constraints and the characteristics of the data suppliers (households, businesses, administrative registers). Future research should be devoted to finding criteria and strategies for balancing between the cooperation level of respondents and the data accuracy (i.e. the types and complexity of edit rules used at the data capturing stage). Effectiveness should be measured in terms of both response rates (response burden), gain in data quality and gain in timeliness. Critical open problems are determining what type and how many edits are to be anticipated at the data collection stage, the optimal timing of when to perform the edits, and how to present the edit failures to the respondents without lowering the overall response rates. Edit checks could in the future become more sophisticated by including previous or complementary external information while preserving confidentiality and developing tailored and personalized data collection modes to meet the respondent's characteristics and technological capabilities. Questionnaire developers and editing methodologists need to work closely together when developing and testing survey questionnaires, in particular for mixed modes of data collection. Gathering information on survey processes through metadata is crucial for improving questionnaires and editing strategies in order to prevent future errors.
- The impact on data quality when moving parts of edits to electronic data collection compared to the traditional approach to data collection and post-data editing has to be effectively tested, measured and evaluated. Methodology needs to be developed and tested for integrating data with varying levels of quality from different data collection modes, and for an optimal mixed editing strategy for harmonizing editing activities performed at the various stages of the survey process. In general, there is a need for more evaluation studies in the area of measuring data quality improvements resulting from partially editing data through electronic data collection versus editing entirely performed after the data collection stage.
- Possible new biases and non-sampling errors, which may arise from mixed modes of data collection and editing, have to be properly measured. Statistical Agencies are moving from traditional paper-and-pencil mode of data capture to mixed data processing strategies, where different electronic-based data capturing technologies and methodologies (Web files, CD, diskettes, personal or telephone surveys using CAI) are combined with paper-and-pencil data collection, and different editing approaches are used over all the survey processes. In this way, respondents not only participate in the editing activities, but they perform these activities in different ways, depending on the specific adopted mode of data

collection. The use of multiple questionnaires and different tools for data capturing in the survey process for sub-groups of respondents result in different response rates on each data collection mode. Mixed approaches to data collection and editing produce an increasing complexity for the integration and management of the overall information flow, and imply additional efforts for integrating, rationalizing and optimising editing activities performed over the different parts of the survey process.

- There is a need to raise awareness and increase response rates for Web-based and self-administered questionnaires and especially to deal with issues of confidentiality when data are collected over the Internet. Since user concerns about confidentiality, privacy, and data security could have an impact on response rates, efforts are to be made to identify technological and methodological tools for improving the preservation of data confidentiality, as well as designing strategies for managing the security issues for the transfer of data, in particular over the Internet.

Summary points and future areas for research for *editing strategies when external and administrative data are used in the statistical survey process* are:

- The balance between maintaining a complex survey processing system integrating data from multiple sources and the development and implementation of efficient editing strategies must be assessed and evaluated. In particular, determining the appropriate edits on external and administrative data, balancing between automatic and manual editing, and utilizing external and administrative data with low quality are open areas of research that need to be explored and tested.
- New methodologies need to be developed for incorporating and utilizing external and administrative data in the statistical processes, such as for quantifying frame coverage errors, for editing and imputing missing or erroneous survey data, and for statistical modeling to compensate for non-response. To make the use of external and administrative data as efficient as possible and to ensure that new biases will not be introduced into the statistical data, more research and development must go into integrating databases, record linkage processes and measuring inconsistencies and errors between sources of data.
- Statistical Agencies need to increase cooperation and determine appropriate incentives that will improve the overall communication and interaction with data suppliers, in order to get them to set up better editing practices and conform to statistical classifications and definitions, and to provide feedback to the agency in the data verification process.

The continuous IT developments and the growing availability of electronic external data on households, persons and businesses is deeply changing the way Statistical Agencies perform their own statistical survey processes. Electronic data capturing and transmission are more and more exploited, with an increasing need to develop methodologies and strategies for adapting traditional processes (including E&I) to the new context. This new overall approach implies both advantages and drawbacks. One advantage relates to the general increase of response rates and data accuracy due to using the most suitable mode of data collection for the type of respondents and the information required. In addition, respondent burden and costs can be reduced, particularly when external and administrative data are incorporated into the survey

processes. These situations, however, are characterized by a high complexity from both an operational and methodological point of view. In the specific area of E&I, critical problems are the integration and harmonization of the editing activities performed at the different data collection stages and at the post-data collection editing stage for both survey and external and administrative data, as well as the rationalization of the available resources among these phases of the survey process. Further experiments and applications are needed to identify, for each specific situation, the best and most suitable editing strategy depending on the source of the data and the resources and costs required for the design and test phases.

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Section 3:

Links to Selected Other Background Papers

Links to Selected Other Background Papers

The Federal Committee on Statistical Methodology (FCSM) has produced only a limited printing of this volume for Workshop attendees and members of the federal statistical community who routinely receive the reports in the FCSM's Statistical Policy Working Papers series. Because of the short shelf-life of any report on Internet data collection, it was determined that a full print run in hardcopy would not be useful or cost effective. Instead, the Web Surveys Subcommittee has arranged to make this volume and a limited selection of other papers available on the FCSM's Internet site at www.fcsm.gov.

The references in the papers included in this volume and the papers below are intended to provide an introduction to the current state-of-the-art of Web surveys for persons/ households and for business data collection in the federal statistical arena. This list is by no means complete or comprehensive and, no doubt, misses many excellent references that could broaden our understanding and knowledge of the best practices in Web data collection. It simply represents those papers that were brought to the attention of the editors at the time these materials were being compiled.

Experts in the field who wish to forward other papers for posting to the FCSM Internet site may do so by sending an electronic copy for consideration to Gerald W. Gates, Chair, Web Surveys Subcommittee at Gerald.w.gates@census.gov.

Interactive Features in Web Surveys
Frederick G. Conrad, Mick P. Couper, University of Michigan; and Roger Tourangeau, Joint Program in Survey Methodology – www.fcsm.gov

Usability, Compatibility, and Data Quality Across Modes and Technologies in Census Data Collection: A Discussion of Relevant Findings and Gaps in the Literature
Fred Conrad and Mick Couper, University of Michigan – www.fcsm.gov

Survey Data Collection Over the Internet at the U.S. Bureau of Economic Analysis
Patricia Walker, Bureau of Economic Analysis – www.bea.gov/bea/papers.htm

Changes to Editing Strategies when Establishment Survey Data Collection Moves to the Web
Amy Anderson, U.S. Census Bureau; Stephen Cohen, Bureau of Labor Statistics; Elizabeth Murphy, U.S. Census Bureau; Elizabeth Nichols, U.S. Census Bureau; Richard Sigman, U.S. Census Bureau; and Diane Willimack, U.S. Census Bureau – www.bls.gov/bls/fesacp2032103.htm

Designing Edits for Electronic Economic Surveys and Censuses: Issues and Guidelines
Amy E. Anderson, Elizabeth D. Murphy, Elizabeth M. Nichols, Richard S. Sigman, and Diane K. Willimack, U.S. Census Bureau – www.fcsm.gov

Electronic Data Reporting – Moving Editing Closer to Respondents
Paula Weir, Energy Information Administration – http://www.unece.org/cgi-bin/std.aa.mail.pl?xxx:/stats/documents/2003/10/sde/wp.37.e.mme:00009F

Section 4:

Conference Materials

FCSM-GSS Workshop on Web-Based Data Collection

Monday, April 26, 2004
Bureau of Labor Statistics Conference Center
2 Massachusetts Avenue, NE, Washington, DC

Preliminary Program

8:00 - 9:00 AM	Registration and Continental Breakfast	
Concurrent Sessions		
	Business Track	**Household Track**
9:00 - 10:30 AM	**Session 1: Usability and Technology Issues**	**Session 2: Design, Usability, and Technology Issues**
Panelists	Diane Willimack, U.S. Census Bureau	Roger Tourangeau, Joint Program in Survey Methodology, University of Maryland
	James O'Reilly, Westat	Jocelyn Burgess, Statistics Canada
	Tony Labillois, Statistics Canada	Betty Murphy, U.S. Census Bureau
Moderator	Dennis Fixler, Bureau of Economic Analysis	Wendy Alvey, U.S. Census Bureau
10:30 - 11:00 AM	Break	Break
11:00 AM - 12:30 PM	**Session 3: Coverage and Quality**	**Session 4: Sampling (Coverage) and Quality**
Panelists	Bill Mockovak, Bureau of Labor Statistics	Reg Baker, Market Strategies
	Tim Gabel, Research Triangle Institute	Norman Nie, Stanford University
	Sam Best, University of Connecticut	Mark Pierzchala, Mathematica Policy Research
Moderator	Nancy Kirkendall, Energy Information Administration	Gerald W. Gates, U.S. Census Bureau
12:30 -1:30 PM	Lunch	
Plenary Session		
1:30 - 3:30 PM	**Session 5: Lessons Learned and Agenda for the Future**	
Panelists	Paula Weir, Energy Information Administration Patricia Walker, Bureau of Economic Analysis Nancy Bates, U.S. Census Bureau Jeanette Thornton, Office of Management and Budget Roger Tourangeau, Joint Program in Survey Methodology	
Moderator:	Brian Harris-Kojetin, Office of Management and Budget	

Government Statistics Section
American Statistical Association

FCSM-GSS Workshop on Web-Based Data Collection

Attendees List

Bureau of Labor Statistics Conference Center
Monday, April 26, 2004

Wendy Alvey*
U.S. Census Bureau
4700 Silver Hill Road
Room 2423-3 Mail Stop 3700
Washington, DC 20233-3700
Phone: (301) 763-2485
Fax: (301) 457-2485
E-mail: Wendy.l.alvey@census.gov

Amy E. Anderson
U.S. Census Bureau
4700 Silver Hill Road
Room 3108-4, Mail Stop 6200
Washington, DC 20233-6200
Phone: (301) 763-7544
Fax: (301) 457-2304
E-mail: Amy.e.anderson@census.gov

Reginald Baker*
Market Strategies
20255 Victor Parkway
Suite 400
Livonia, MI 48152
Phone: (734) 542-7600
Fax: (734) 542-7620
E-mail:
Reg_baker@marketstrategies.com

Noel Balthasar
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC 20585-0001
Phone: (202) 586-1853
Fax: (202) 586-0448
E-mail: Noel.balthasar@eia.doe.gov

Betty Barlow
Energy Information Administration
1000 Independence Avenue, SW
EI-13
Washington, DC 20585
Phone: (202) 586-8746
Fax: (202) 586-0448
E-mail: Betty.barlow@eia.doe.gov

Nancy Bates*
U.S. Census Bureau
649 A Street, NE
Washington, DC 20002
Phone: (202) 395-3585
Fax: (202) 395-7245
E-mail: Nbates@omb.eop.gov

Daniel Beckler
National Agricultural Statistics Service
3251 Old Lee Highway
Room 305
Fairfax, VA 22030
Phone: (703) 877-8000 x131
Fax: (703) 877-8042
E-mail: Dan_beckler@nass.usda.gov

Mary-Alice Berlin
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Room 5110
Washington, DC 20212
Phone: (202) 691-7553
Fax: (202) 691-7576
E-mail: Berlin_m@bls.gov

Sam Best*
University of Connecticut
341 Mansfield Road
Storrs, CT 06269-1032
Phone: (860) 486-2451
Fax: (860) 486-6656
E-mail: Sbest@uconn.edu

Chester E. Bowie
U.S. Census Bureau
4700 Silver Hill Road
Mail Stop 8400, Room 3324-3
Washington, DC 20233
Phone: (301) 763-3773
Fax: (301) 457-2306
E-mail: Chester.e.bowie@census.gov

Howard Bradsher-Fredrick
Energy Information Administration
1000 Independence Avenue, SW
Routing E1-70
Washington, DC 20585
Phone: (202) 287-1721
Fax: (202) 287-1705
E-mail: Howard.bradsher-fredrick@eia.doe.gov

Amy Branum
National Center for Health Statistics
3311 Toledo Road
Room 6113
Hyattsville, MD 20782
Phone: (301) 458-4731
Fax: (301) 458-4037
E-mail: Ambranum@cdc.gov

Stephanie H. Brown
U.S. Census Bureau
4700 Silver Hill Road
Room WP2 508, Mail Stop 6800
Washington, DC 20233
Phone: (301) 763-1489
Fax: (301) 457-3458
E-mail: Stephanie.h.brown@census.gov

Jocelyn Burgess*
Statistics Canada
5-A8, Jean-Talon Building
Ottawa, Ontario CANADA K1A OT6
Phone: (613) 951-5382
Fax: (613) 951-4674
E-mail: Jocelyn.burgess@statcan.ca

Kevin Cecco
Internal Revenue Service
P.O. Box 2608
Washington, DC 20013
Phone: (202) 874-0464
Fax: (202) 874-0922
E-mail: Kevin.cecco@irs.gov

Promod Chandhok
Bureau of Transportation Statistics
400 Seventh Street, SW
Room 4432
Washington, DC 20590
Phone: (202) 366-2158
Fax: (202) 366-3385
E-mail: Promod.chandhok@bts.gov

Christopher D. Chapman
National Center for Education Statistics
Station 9086
1990 K Street, NW
Washington, DC 20006
Phone: (202) 502-7414
Fax: (202) 502-7475
E-mail: Chris.chapman@ed.gov

Stephen H. Cohen
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Room 1950
Washington, DC 20212
Phone: (202) 691-7400
Fax: (202) 691-7426
E-mail: Cohen.steve@bls.gov

Quentin Coleman
National Agricultural Statistics Service
1400 Independence Avenue, SW
Room 6312A South Building
Washington, DC 20250-2010
Phone: (202) 720-8646
Fax: (202) 720-9260
E-mail: Qcoleman@nass.usda.gov

Marcie Cynamon
National Center for Health Statistics
3311 Toledo Road
Room 2113
Hyattsville, MD 20782
Phone: (301) 458-4174
Fax: (301) 458-4035
E-mail: Mcynamon@cdc.gov

Diane Dixon
Internal Revenue Service
P.O. Box 2608
Washington, DC 20013
Phone: (202) 874-0385
Fax: (202) 874-0922
E-mail: Diane.m.dixon@irs.gov

Hossain Eftekhari-Sanjani
Bureau of Transportation Statistics
400 Seventh Street, SW
Washington, DC 20590
Phone: (202) 493-2200
Fax: (202) 366-3385
E-mail: Hossain.sanjani@bts.gov

Martha Farrar
National Agricultural Statistics Service
1400 Independence Avenue, SW
Room 6312A South Building
Washington, DC 20250-2010
Phone: (202) 720-2837
Fax: (202) 720-9260
E-mail: Mfarrar@nass.usda.gov

Dennis Fixler*
Bureau of Economic Analysis
1441 L Street, NW
BE-7
Washington, DC 20212
Phone: (202) 606-9607
Fax: (202) 606-5311
E-mail: Dfixler@bea.gov

Jean E. Fox
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Room 1950
Washington, DC 20212
Phone: (202) 691-7370
Fax: (202) 691-7426
E-mail: Fox.jean@bls.gov

Mary Frase
National Science Foundation
4201 Wilson Boulevard
Suite 965
Arlington, VA 22230
Phone: (703) 292-7767
Fax: (703) 292-9092
E-mail: Mfrase@nsf.gov

Kathy Frederickson-Mele
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Suite 5110
Washington, DC 20212
Phone: (202) 691-6102
Fax: (202) 691-7576
E-mail: Mele.kathy@bls.gov

Tim Gabel*
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
Phone: (919) 541-7415
Fax: (919) 541-8084
E-mail: Tjg@rti.org

Gerald W. Gates*
U.S. Census Bureau
8524 Wagon Wheel Road
Alexandria, VA 22309
Phone: (301) 763-2515
Fax: (301) 457-2654
E-mail: Gerald.w.gates@census.gov

Michael W. Gerling
National Agricultural Statistics Service
3251 Old Lee Highway
Fairfax, VA 22030
Phone: (703) 877-8000 x113
Fax: (703) 877-8044
E-mail: Mgerling@nass.usda.gov

Lee Giesbrecht
Bureau of Transportation Statistics
400 Seventh Street, SW
Room 4322
Washington, DC 20590
Phone: (202) 366-2546
Fax: (202) 366-3385
E-mail: Lee.giesbrecht@bts.gov

Jimmie Givens
National Center for Health Statistics
3311 Toledo Road
Room 3223
Hyattsville, MD 20872
Phone: (301) 458-4236
Fax: (301) 929-2801
E-mail: Jdg3@cdc.gov

Linda Gail Gregory
National Agricultural Statistics Service
1400 Independence Avenue, SW
Room 5334-B
Washington, DC 20250
Phone: (202) 720-6203
Fax: (202) 720-6396
E-mail: Gail_gregory@nass.usda.gov

Janet Greenblatt
Agency for Healthcare Research and Quality
540 Gaither Road
Rockville, MD 20850
Phone:
Fax:
E-mail: Jgreenbl@AHRQ.gov

James Griffith
National Center for Education Statistics
1990 K Street, NW
Room 8103
Washington, DC 20006
Phone: (202) 502-7387
Fax: (202) 502-7490
E-mail: James.griffith@ed.gov

Mary Diane Harley
U.S. Census Bureau
4700 Silver Hill Road
Room 2524-3, Mail Stop 6100
Washington, DC 20233-6100
Phone: (301) 763-4125
Fax: (301) 457-1236
E-mail: Mharley@census.gov

Brian Harris-Kojetin*
Office of Management and Budget
9205 Mintwood Street
Silver Spring, MD 20901
Phone: (202) 395-7314
Fax: (202) 395-7245
E-mail: Bharrisk@omb.eop.gov

Bradford Hesse
National Cancer Institute
6130 Executive Boulevard
Rockville, MD 20852
Phone: (301) 594-9904
Fax: (301) 480-2198
E-mail: Hesseb@mail.nih.gov

Matthew J. Hickman
Bureau of Justice Statistics
810 Seventh Street, NW
Washington, DC
Phone: (202) 353-1631
Fax: (202) 616-1351
E-mail: Hickmanm@ojp.usdoj.gov

Stephen P. Holliday
Bureau of Economic Analysis
BE-10
Washington, DC 20230
Phone: (202) 606-9922
Fax: (202) 606-5315
E-mail: Stephen.holliday@bea.gov

Kelly Kang
National Science Foundation
4201 Wilson Boulevard
Suite 965
Arlington, VA 22230
Phone: (703) 292-7796
Fax: (703) 292-9092
E-mail: Kkang@nsf.gov

Daniel Kasprzyk
Mathematica Policy Research, Inc.
600 Maryland Avenue, SW
Suite 550
Washington, DC 20024
Phone: (202) 484-3482
Fax: (202) 484-9512
E-mail: Dkasprzyk@mathematica-mpr.com

Steven Kaufman
National Center for Education Statistics
1990 K Street, NW
Washington, DC 20006
Phone: (202) 502-7371
Fax:
E-mail: Steve.kaufman@ed.gov

Nancy Kirkendall
Energy Information Administration
1000 Independence Avenue, SW
EI-70
Washington, DC 20585
Phone: (202) 287-1706
Fax: (202) 287-1705
E-mail: Nancy.kirkendall@eia.doe.gov

John Kraemer
Office of Management and Budget
Washington, DC 20503
Phone: (202) 395-4816
Fax: (202) 395-6974
E-mail: John_kraemer@omb.eop.gov

Tony LaBillois*
Statistics Canada
5-A Jean-Talon Building
Ottawa, Ontario CANADA K1A OT6
Phone: (613) 951-1478
Fax: (613) 951-4674
E-mail: Tony.labillois@statcan.ca

Nancy L. Leach
National Science Foundation
4201 Wilson Boulevard
Suite 965
Arlington, VA 22230
Phone: (703) 292-7768
Fax: (703) 292-9092
E-mail: Nleach@nfs.gov

Amanda Lee
Office of Management and Budget
725 17th Street, NW
Room 10202
Washington, DC 20503
Phone: (202) 395-3084
Fax: (202) 395-7285
E-mail: Alee@omb.eop.gov

Jeffrey M. Little
U.S. Census Bureau
4700 Silver Hill Road
Room WP2-412, Mail Stop
Washington, DC 20233
Phone: (301) 763-7246
Fax: (301)
E-mail:
Jeffrey.michael.little@census.gov

Margie Malanoski
Office of Management and Budget
725 17th Street, NW
Room 10202
Washington, DC 20503
Phone: (202) 395-3122
Fax: (202) 395-7285
E-mail: Mmalanos@omb.eop.gov

Michael Margreta
Bureau of Transportation Statistics
400 Seventh Street, SW
Room 4432, Mailstop K-23
Washington, DC 20590
Phone: (202) 366-4748
Fax: (202) 366-3385
E-mail: Michael.margreta@bts.gov

William C. McCready
Knowledge Networks, Inc.
10 South Riverside Plaza
Suite 1800
Chicago, IL 60606
Phone: (312) 474-6464
Fax: (708) 524-1241
E-mail:
Bmccready@knowledgenetworks.com

Preston McDowney
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC 20585
Phone: (202) 287-1719
Fax: (202) 287-1785
E-mail: Pmcdowne@eia.doe.gov

William Mockovak*
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Washington, DC 20212
Phone: (202) 691-7414
Fax: (202) 691-7426
E-mail: Mockovak_w@bls.gov

Mary Moien
National Center for Health Statistics
3311 Toledo Road
Room 7115
Hyattsville, MD 20782
Phone: (301) 458-4389
Fax:
E-mail: Mmoien@cdc.gov

Elizabeth Murphy*
U.S. Census Bureau
4700 Silver Hill Road
Room 3133-4, Mail Stop 9100
Washington, DC 20233-9100
Phone: (301) 763-4858
Fax: (301) 457-4931
E-mail: Elizabeth.d.murphy@census.gov

Norman H. Nie*
Stanford Institute for the Quantitative
Study of Society
Stanford University
417 Galvez Mall
Encina West, Room 104
Stanford, CA 94305-6074
Phone: (650) 723-7353
Fax: (650) 723-7351
E-mail: Nhnie@stanford.edu

James O'Reilly*
WESTAT
2736 Old Sugar Road
Durham, NC 27707
Phone: (919) 419-1733
Fax: (919) 403-9045
E-mail: Jimoreilly@westat.com

Jeffrey Owings
National Center for Education Statistics
1990 K Street, NW
Washington, DC 20006
Phone: (202) 502-7423
Fax: (202) 502-7475
E-mail: Jeffrey.owings@ed.gov

Mark Pierzchala
Mathematica Policy Research
816 Fordham Street
Rockville, MD 20850
Phone: (202) 484-4231
Fax:
E-mail: Mpierzchala@mathematica-mpr.com

Cleo Redline
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
Phone: (703) 292-7802
Fax: (703) 292-9092
E-mail: Credline@nsf.gov

Bryce Reeve
National Cancer Institute
6130 Executive Boulevard
EPN 4005, MSC 7344
Bethesda, MD 20892-7344
Phone: (301) 594-6574
Fax: (301) 435-3710
E-mail: Reeveb@mail.nih.gov

Marsha E. Reichman
National Cancer Institute
6116 Executive Boulevard
Suite 504
Bethesda, MD 20892
Phone: (301) 594-7032
Fax: (301) 480-4077
E-mail: Reichmam@mail.nih.gov

Michelle Roberts
Agency for Healthcare Research and Quality
540 Gaither Road
Rockville, MD 20850
Phone: (301) 427-1645
Fax: (301) 427-1276
E-mail: Mroberts@ahrq.gov

Richard Rosen
Bureau of Labor Statistics
2 Massachusetts Avenue, NE
Suite 4860
Washington, DC 20212
Phone: (202) 691-6524
Fax: (202) 691-6644
E-mail: Rosen_r@bls.gov

Susan Schechter
Office of Management and Budget
725 17th Street, NW
Room 10201
Washington, DC 20503
Phone: (202) 395-5103
Fax: (202) 395-7245
E-mail: Susan_schechter@omb.eop.gov

Elois Scott
National Center for Education Statistics
1990 K Street, NW
Room 9010
Washington, DC 20006
Phone: (202) 502-7489
Fax: (202) 502-7468
E-mail: Elois.scott@ed.gov

Gerald Silverstein
Bureau of Economic Analysis
BE-40
Washington, DC 20230
Phone: (202) 606-9653
Fax:
E-mail: Gerald.silverstein@bea.gov

Julius Smith Jr.
U.S. Census Bureau
4700 Silver Hill Road
Room 2135-4, Mail Stop 6900
Washington, DC 20233
Phone: (301) 763-7662
Fax: (301) 457-1318
E-mail: Julius.smith.jr@census.gov

Rachel Steinfeld
National Center for Health Statistics
3311 Toledo Road
Room 6308
Hyattsville, MD 20782
Phone: (301) 458-4301
Fax: (301) 458-4037
E-mail: Bkn9@cdc.gov

T. C. Swann
Energy Information Administration
EI-54
1000 Independence Avenue, SW
Washington, DC 20585
Phone: (202) 287-1616
Fax: (202) 287-1934
E-mail: Tc.swann@eia.doe.gov

Jeanette Thornton*
Office of Management and Budget
725 17th Street, NW
Room 10236
Washington, DC 20503
Phone: (202) 395-3562
Fax: (202) 395-5167
Email: Jthornto@omb.eop.gov

Roger Tourangeau*
Joint Program in Survey Methodology
University of Maryland
1218 LeFrak Hall
College Park, MD 20742
Phone: (301) 314-7984
Fax: (301) 314-7912
E-mail: Rtourang@survey.umd.edu

Patricia C. Walker*
Bureau of Economic Analysis
BE-69A
Washington, DC 20230
Phone: (202) 606-5566
Fax: (202) 606-5312
E-mail: Patricia.walker@bea.gov

Paula Weir*
Energy Information Administration
1000 Independence Avenue, SW
Washington, DC 20585
Phone: (202) 586-1262
Fax: (202) 586-4913
E-mail: Paula.weir@eia.doe.gov

Diane Willimack*
U.S. Census Bureau
4700 Silver Hill Road
Room 3110-4, Mail Stop 6200
Washington, DC 20233
Phone: (301) 763-3538
Fax: (301) 457-2304
E-mail: Diane.k.willimack@census.gov

Marianne W. Zawitz
Bureau of Justice Statistics
810 Seventh Street, NW
Washington, DC 20531
Phone: (202) 616-3499
Fax: (202) 354-4124
E-mail: Zawitzm@ojp.usdoj.gov

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1. ***Report on Statistics for Allocation of Funds***, 1978 (NTIS PB86-211521/AS)
2. ***Report on Statistical Disclosure and Disclosure-Avoidance Techniques***, 1978 (NTIS PB86-211539/AS)
3. ***An Error Profile: Employment as Measured by the Current Population Survey***, 1978 (NTIS PB86-214269/AS)
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36. ***Seminar on the Funding Opportunity in Survey and Statistical Research.*** 2004.
37. ***Federal Committee on Statistical Methodology Research Conference (Conference Papers)***, 2003.

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