

EMPIRIACAL STUDY ON THE EFFECTIVENESS OF E-SURVEY METHOD IN WEB-BASED ENVIRONMENT

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Abstract

The communication services have changed rapidly due to the explosive growth in popularity of the Internet and Web-based technology. The current research was motivated by the growing trend towards the realization of Web-based technology. In this paper the development of a management tool, e-survey system design is described. Although the methodology lacks the scientific rigor of planning and is controlled, analysis is discussed to help understand the limitations and process of survey through Internet. The merits of the e-survey system are explored, and the behavior of the e-survey is also studied.

Key words: Internet technology, WWW, e-survey, Email-by-Web method, Web-based environment, management tool.

Introduction

With the technology changing so rapidly in global competition, one must constantly reassess or re-evaluate barriers to see if they still exist or if new technology offers new opportunities. This will lead to higher effective and efficient in meeting the needs of the client and ultimately the client's clients. The removal of these barriers will be the successful factor to achieve a process of continuous improvement for all organizations.

Internet is a global network of computers linked by a standard communications protocol. It has become the symbol of the information age and a means for accessing and sharing information now extending throughout the whole culture of human beings. The Internet and the

Universal Resource Locator (URL) of the World Wide Web (WWW) are linked to virtually all other types of communications media including newspapers, magazines, television, and radio. The World Wide Web (WWW) is a graphical interface to Internet. It is at present probably the most popular application on the Internet. It is a technology that promises to supply any information needed in any format, to answer any question, and to replace much of print media. Since its inception, the World Wide Web, or WWW or Web, [1] has grown dramatically in the number of users, servers, and its geographical distribution [2]. These technologies for the first time hold the potential of ushering in the "Age of Information"[3] to people of all ages, backgrounds, and economic status.

Internet technology coupled with the ease of publishing multimedia materials within the Web will support radical changes in areas such as engineering, medicine, education, business, and entertainment. The promise of widespread and instant access via the Internet and WWW has already spurred research into the potential for improving surveys. The early research will focus on business establishment surveys since Internet access has penetrated much further than in households [4].

The overall scenario of communication services has changed in popularity of the Internet, which has two major implications for survey research. [5,6] First, as access to the Internet becomes more widespread, it may become a useful alternative to telephone services for data collection modes that require high availability. Second, the popularity of the Internet is driving the development of higher bandwidth data communications systems that are technically and economically viable for residential as well as institutional use. Internet use has increased so dramatically over the last few

years that some estimated that the number of interactive Internet user accounts worldwide would exceed 152 million in the year 2000 [7]. Some on-line survey data collection via Internet will not require particularly high bandwidths or sophisticated communications infrastructure. So the critical factor for the success of the Internet for survey research is likely to be the penetration of Internet access in terms of the target population. The recent introduction of advanced tools and approaches in Web-based environment has opened a variety of possibilities for encouraging such access. New applications in such domains as e-mail-based services [8], Hyper Text Markup Language (HTML) extensions and Database integrators[9] are characterized by an unprecedented mix of features that makes current e-survey method different from previous ones. Its advantages are not limited to response rates. Additionally, the submission, storage, collation, and analysis processes all occur in an electronic medium, limiting human effort to developing processing programs and ensuring the integrity of the collected data.

There were two goals motivating this study. First, it was wished to demonstrate a proof of concept for Web-based environment as a useful survey medium. Second, by discussing the development of the e-survey system with Email-by-Web method, it was hoped to foster a correct understanding and use of new WWW development paradigms, compare different survey methods in various aspects and then yield guideline for future e-survey design.

Managment Research Tool

There is a similarity between research process and management process that suggests they need one another. Management research is a systematic, careful inquiry of anything to do with management. It is not

difficult to establish the relevance of research to management education in its broadest meaning. Since both management and research are decision-making processes, it suggests that managers are their own researchers in many circumstances. The good manager is, at least unconsciously, a good researcher too. The most general techniques that a researcher goes about acquiring information are observation, interviews and questionnaires. Whilst questionnaires are undoubtedly the most used technique, the major difficulties are associated with bias, response rates and flexibility.

A key issue in management research is the choice of the most appropriate survey method. The fundamental principles of survey research were formulated when paper and pencil methods (P&P) [¹⁰] provided the only alternative of survey data collection. In the last half of century, survey research has undergone many important changes. These have included the development of applied probability sampling, the growth of telephone interviewing, new approaches to statistical analysis, a greater understanding of non-sampling bias and error, the evolution of panel survey methods, and the appreciation of cognitive psychology principles in questionnaire design. Yet, none of these changes may have more far-reaching effects on survey research than the application of computer technology to survey data collection and capture. This transition promises to be a crucial turning point for survey practice. The introduction of computer-based collection methods [¹¹] is changing the way surveys are conducted and the way many of its issues are defined, but the basic principles of survey research remain unchanged. New data collection technologies are not an alternative to high standards of survey methods but a new means of achieving and advancing such standards.

Using the Web-based technology to conduct survey is not new. However, most of these surveys have typically been an inadequate level of participation and respondents. It is believed that the lack of respondents is primarily due to the overhead incurred. That is, most surveys ask the users to report their responses via electronic mail. For example, a Web-based survey that required e-mail responses was published through Internet in late January 1994 [¹²]. The results of the survey revealed that only fifty-five responses were gathered. There have been a lot of questions about e-mail security and reliability. In the early days it was common that e-mails misdespatched to wrong addressees. Many companies thus refuse to send confidential documentation over the Internet. In addition, e-mail is not looked upon as legal document. Nevertheless, the major strength of the e-mail survey is its ability to conduct survey widely, without geographical bound, dispersed populations at very low cost.

Fortunately, the level of client interactivity supported by Hypertext Markup Language Plus [HTML+], i.e. forms, is sufficient to enable low-overhead, point and click responses, as well as text entry. Further enhancing the attractiveness of using Web-based technologies is the Hypertext Transfer Protocol [HTTP] server's ability to retrieve documents (the actual surveys) *and* execute programs (response logging software). Thus, not only are users able to respond to surveys in an intuitive, non-labor intensive manner, but the results can be logged automatically via the HTTP server.

Research Framework

Understanding research begins with knowing what, in essence, it is all about. The research process usually starts with some form of problem or question. The

starting point is represented by an urge to find out, to explore and to evaluate. There are many tools for the development of WWW survey methodology. These tools include the respondent contact procedures analogous to those used in Touch-tone Data Entry (TDE) [13], and the automated self-interviewing techniques familiar from Computerized Self-administered Questionnaires (CSAQ) [14]. Existing TDE and Voice Recognition (VR) methods [15] largely eliminate labor-intensive activities for mail-out, mail-back, and data entry. However, both methods address directly another expensive activity: data editing and reconciliation. The current labor-intensive edit and reconciliation operations can also be directly handled in the Web-based environment, which allows respondent to review directly seeming edit failures and correct them as necessary.

In Web-based environment, the operation of most survey data collection can be fully automated and the overall process can be simplified for both the survey agency and respondent. The e-survey collection cycle begins with a sample control file containing the respondent's e-mail address in addition to the normal respondent contact information such as name, address, and phone number. The collected form is a standard "web page" containing an image of the questionnaire, survey instructions, definitions, and hypertext links to the definitions. An e-mail address of the system administrator is provided for problem reporting and inquiries. As the collection cycle begins, the respondent opens his or her e-mail to find a reminder, points a browser to the survey homepage, accesses the data collection screen, and fills in the requested data. At the moment the respondent clicks the "submit" icon, data are then transferred to the survey agency. The collection system electronically checks in the schedules, and at predetermined time periods, sends e-mail

non-response to reminder packages containing the full original information. During data collection, the system conducts automated edits or notes otherwise failure messages on the screen.

Many analogies have been made comparing traditional mail to e-mail based survey methods [16]. In many ways they are quite alike in their visual presentation and their "page-based" orientation, while the speed of delivery is an important difference. In view of their similarities, existing research into traditional methods provides a strong basis for e-survey system design in Web-based environment and for attaining the highest possible response rates. One well-researched and documented framework is the Total Design Method (TDM) [17]. The TDM states that response rates can be maximized when three basic tenets are incorporated into the survey design;

- Maximize respondent rewards;
- Minimize the costs of reporting;
- Establish trust that rewards will actually be delivered.

Implementation

The WWW has four characteristics that may fulfill these requirements. First, the page-based design of a WWW collection system only shows the "pages" or screens based on previous interviews and prior answers. All other portions of the questionnaire remain unseen, limiting burden and crowding. This easy-to-complete screen encourages response.

Second, "the Internet is scaleable," says Bill Gates, founder and chairman of Microsoft Corporation, "in the sense that if something really catches your eye, you can be as educated and involved as you want to be" [18]. Applying this to survey design, it

means that large amounts of information can be provided for those who want it. For example, by using visually highlighted hypertext links, definitions and related information can be hidden from viewers. If needed, they can be instantly retrieved simply with a mouse click. (See Figure 1)

For paper-based survey, decision on how much material and information to be provided is both a cost and time issue. However, since the marginal cost of adding information to the WWW server is negligible, people can inexpensively make available a large array of information. Examples include survey background, respondent-specific spreadsheets, published results in printed or graphic form, as well as video or audio clips showing the survey results being used in the media, by businesses, or by policy makers. This electronically stored information would be retrieved solely by respondents specifically

requesting it. Research is needed on how to build in such features to appear helpful, and optional, without being perceived as burdensome.

Third, the WWW is by its very nature on-line and interactive, providing instant feedback-whether for editing, access to the survey-related background information, personalized messages of appreciation, or published output. If well designed, the survey process is self-fulfilling, since the respondent instantly receives requested information from a menu of options linked to electronically stored responses. Last, the WWW has the graphic flexibility to make the questionnaire as interesting as the web page designers' wish. The subject matter may allow audio and video cues. The challenge will be determining the appropriate uses of the WWW's interactive capabilities without being confusing or diverting attention from the questionnaire itself.

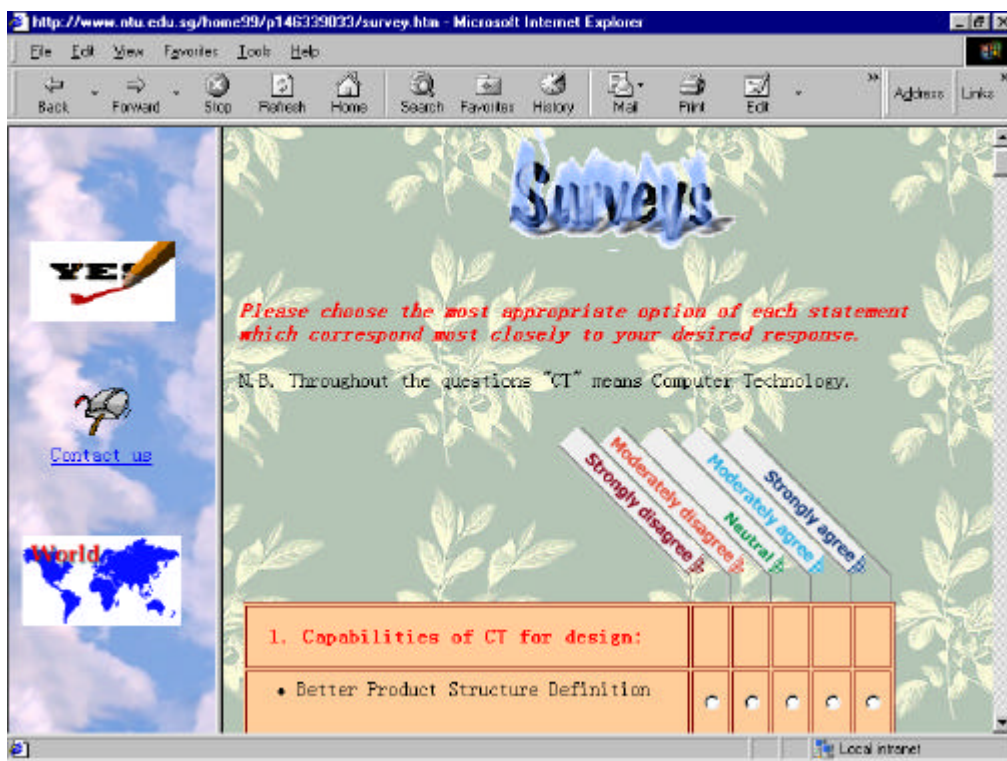


Figure 1 Questionnaire of e-survey

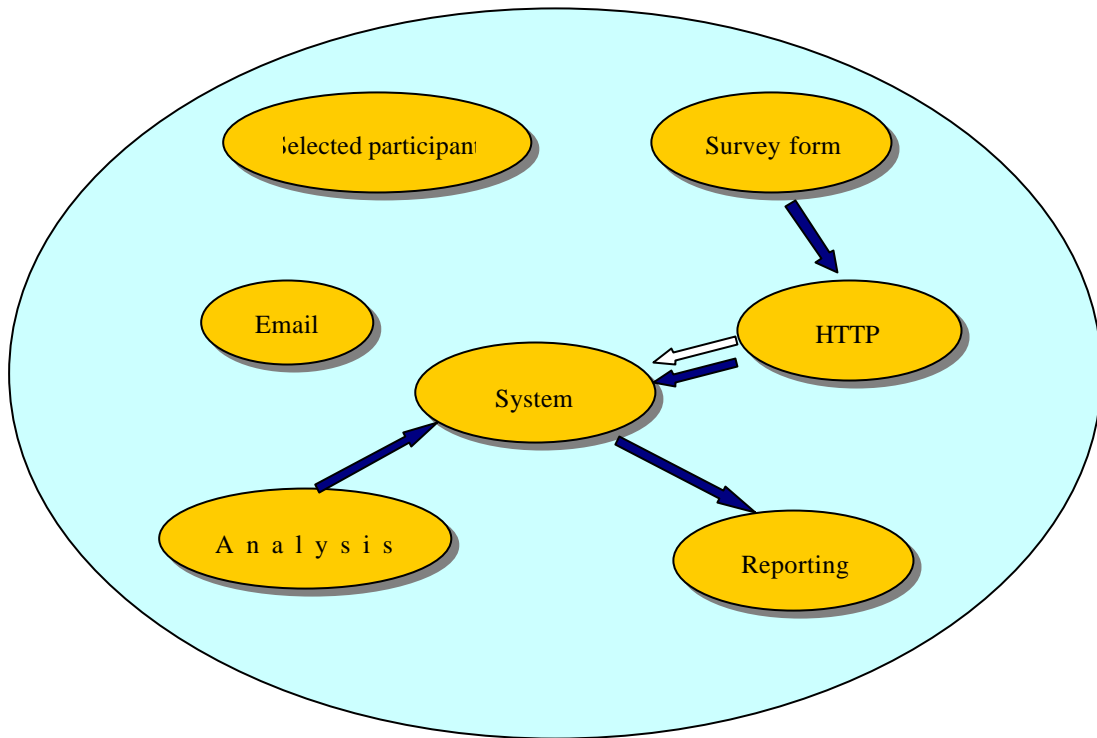


Figure 2 *Email-by-Web* system

Given the ability of the enabling WWW technology, the survey system used in this study is realized in an innovative way: Email-by-Web, which integrated message delivery, database management and result reporting in the Web-based environment. The key components of the **Email-by-Web** system are a HTTP server, a homepage for survey form and a simple database text file to store data (See Figure 2). The system kernel is a program which helps store responses into a plain-text data file. It is an extension of Formmail.pl, a general-purpose submission form. The program itself is stored on the HTTP server, while the database text file also resides there for the

program to append records. Majority of the extra functionality for the system was provided through the CGI interface with HTML scripts. This approach was designed to leverage off of the hidden attributes of the TYPE field used in input forms in HTML. The data are passed from the respondents to the server via POST method. Such kind of program can be found in many free Web account providers. Thus, what users do are just copying and modifying approximately 20 lines of original codes in the survey form homepage HTML, then data can be gotten directly from the server (shown on Figure 2: black arrow indicates mailback; white arrow indicates database text file).

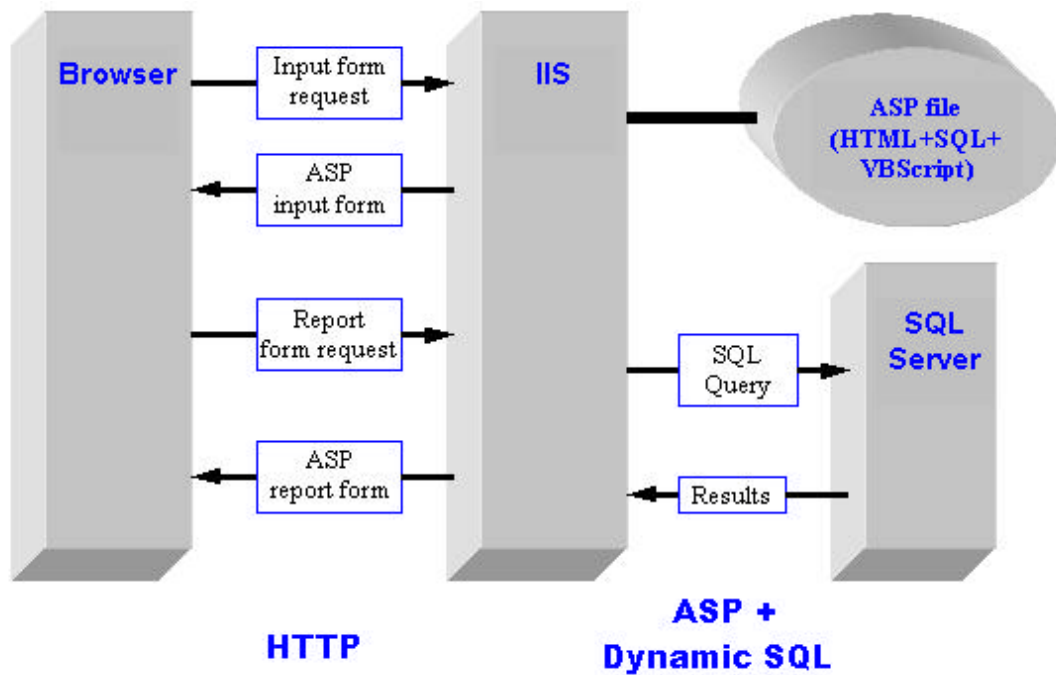


Figure 3 Control flow of input-output forms

This study also provides an overview of how to use Active Server Pages (ASP), a HTML extension, to build database applications for the web to display survey results according to the users' requests. The survey result application is contained in the ASP file. To reiterate, the survey results application creates two distinct elements: the input form and report form. The report form is generated from the user input on the input form. This process is illustrated in Figure 3 in which the flow of control during the creation of the input form and report form is simulated.

In the input form, the contents of the input section are pure HTML which include a serious check box where visitors can choose the results to view. Applications written with ASP can use any flavor of HTML, including those that support Java script, Java applets and VB script. So the result display is "dynamic" with the inflation of the mount of the survey data. After

viewing the query input form on the browser, the visitors can now choose the results in the form and submit them for processing. This request is sent to the Internet Information Server (IIS) where the HTML script is invoked with the ASP file and section name report. In addition the variable values corresponding to the selections on the input form are sent to the server. ASP invokes the SQL language environment to allow visitors to read immediately from the database the content of the survey results. With the "liveconnect" feature of VB script, the result display is "dynamic" with the inflation of the mount of the survey data. By sending the dynamic survey results to the visitor's browser and retrieving and interpreting the page in IIS, the visitor's browser receives the only HTML and displays the results of their particular order to the visitor (See Figure 4). To continue, the user can click on "Issue another query" to return to the input form and perform another result lookup.

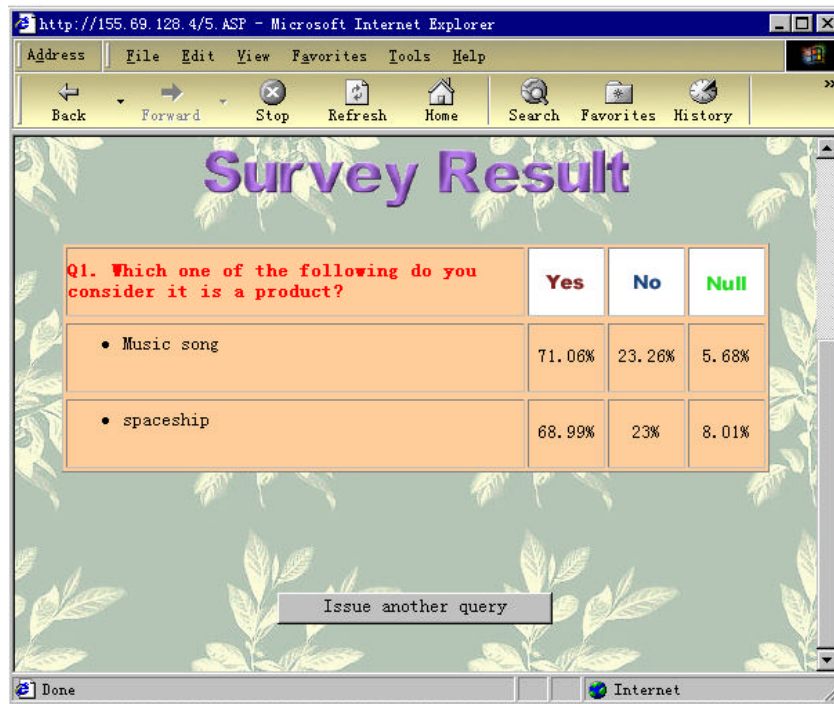


Figure 4 Web page – Survey result report form

Results and Discussions

This Email-by-Web survey system is an effective method for sending and gathering information within the Internet community. It offers advantages such as:

- Majorities of the Internet online users check their incoming email at least once per day. They often respond to the survey at once after they receive the incoming email, if they are free.
- Objective view could be obtained from the respondents, without any influence or interference during the interviewing process (face-to-face).
- Survey by email is a very unintrusive way to contact respondents. Respondents can complete the survey at their convenience time. This will greatly improve and raise the cooperation rates and the quality of their answers.
- The survey content is delivered directly to the respondents' personal Email addresses. There is rarely response interpretation error.
- Respondents give higher quality open-ended responses. It is faster to compile the collected data in comparison to other conventional data collection methods.
- The survey output can be varied in numerous report formats, according to the end user's requirements (e.g., optical questions and respondents' profiles: gender, job function etc.). With the continued development of latter database publishing tools, it is expected that this capability to become increasingly important of attracting participants and thus increasing response rate.

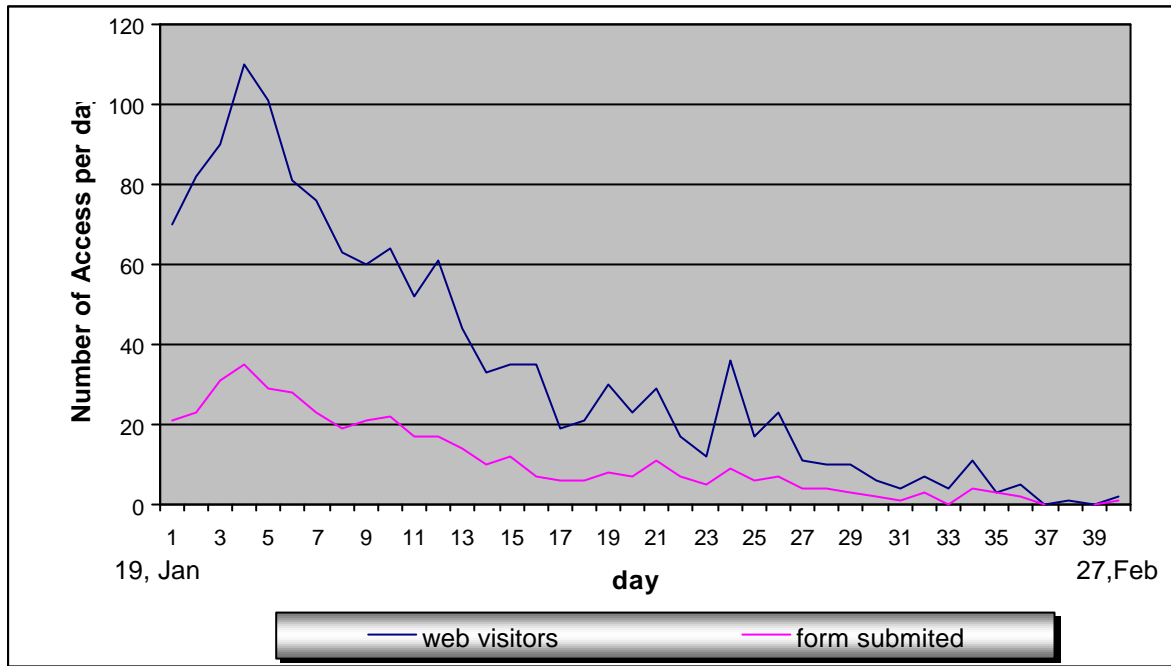


Figure 5 Records of visitors and their responses through the survey period

In the current empirical study, total of 3,500 mailers were sent out through the email in four consecutive days (19, Jan to 22, Jan). The addressees were well spread in 21 countries worldwide. Beginning of the 5th day in this empirical study, the e-survey system was monitored and recorded for the number of visitors and their questionnaire submission. The monitoring program was continuing till the 40th day. This virtual activity over the 40 days period was recorded and the results are shown in Figure 5. The darker color (top) curve in the figure indicates the number of Internet surfers who visited the web site after accepting invitation from their incoming e-mail. The lighter color of (bottom) curve indicates the number of Internet surfers who responded to the survey, by completing and returning their questionnaires. As can be seen, the most evident spikes of both lines took place on the fourth day since the survey started. The trend of the two curves is on generally

alike. It could be interpreted that the respondents accept the invitation to participate in the survey and they replied immediately after reading their incoming email. Otherwise, they ignored or rejected the surveying exercise. There are 428 responses in this survey compared to the total 3,500 mailers dispatched. Most of the responses (about 85%) were replied within the first 20 days. Analyzing from the result, the average ratio of the number of Web visitors to the number of submitted forms is approximately 3:1. From this, 17, or 3.9% invalid submissions were removed. Finally only 412 records were accepted and collated into the final datasets. Nevertheless, these figures are very important since it can be regarded as a reference for the future e-survey design in the Web-based environment.

Although the e-survey method is more effective than the conventional survey

methods, they require considerable end-user efforts, which ought to be avoided if possible. Aggregating from prior knowledge and experience, the authors present the comparison of numerous factors affecting choice, the performance of face-to-face, telephone, mail/fax and Email-by-Web in the following Table 1.

In practice it is possible combining these methods for better and effective survey studies. With the current advance in the computer and Internet technology, it is feasible to conduct an e-survey and to follow up with Internet meeting interviews.

Concluding Remarks

The effectiveness of the process for structured survey in the World Wide Web community is studied and presented in this research paper. To illustrate Internet technology and application can be engaged in survey design, the Email-by-Web method was developed. As demonstrated by the high number of survey respondents, this Email-by-Web method proves to be easy-to-used and reliable. In addition the entire process generally saves time and cost.

The current research was motivated by

Table 1 A comparison of face-to-face, telephone/fax and Email-by-Web

Factor	Methods			
	Face-to-face	Telephone	Mail/Fax	Email-by-Web
Questionnaire				
1. Complex issues	Good	Medium	Poor	Poor
2. Use of open-ended questions	Good	Medium	Poor	Poor
3. Flexibility	Good	Medium	Poor	Medium
4. Ability to probe	Good	Medium	Poor	Medium
5. Use of visual aids	Good	Poor	Good	Good
Resources				
1. Time	Poor	Medium	Good	Good
2. Cost	High	Medium	Low	Low
Sampling				
1. Widely dispersed populations	Poor	Good	Good	Good
2. Delegation to subordinate	Good	Good	Poor	Good
3. Response rates	High	Medium	Low	Medium
Interviewing				
1. Control of who completes questionnaire	High	High	Low	High
2. Interviewer bias	Possible	Possible	Not possible	Not possible

the growing trend towards the realization of technology in Web-based environment. Given that Web-based environment is a useful survey medium, this paper concluded with the comparison on the effectiveness and efficiency of the Email-by-Web method with others conventional survey approaches. By

examining the advantages and pitfalls of these methods, it is hoped to provide further insight into the effectiveness of Web-based applications in the survey design. This study shows the potential application of the e-survey method as a management tool which can not be ignored.

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