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Evaluating Usage and Impact of Networked Electronic Resources through Point-of-Use Surveys: A MINES for Libraries™ Study

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This article presents a literature review of methods for evaluating serials, or networked electronic resources, usage, and focuses on point-of-use intercept Web surveys. In the context of the MINES for Libraries protocol administered by the Association of Research Libraries (ARL) and derived from the indirect cost study methodologies developed by Franklin and Plum, the article discusses a variety of point-of-use Web survey implementation methodologies used in libraries. It discusses sampling plan options and articulates issues related to the mandatory and optional versions of the point-of-use Web survey protocols with an emphasis on nonresponse bias. The article provides a set of methods that libraries can use to continue to evaluate their networked electronic services in innovative ways to better serve the research, teaching, and learning needs of their users.

KEYWORDS MINES for Libraries, Association of Research Libraries, statistics, assessment, Web surveys, digital libraries, networked electronic resources, sampling plans, response rates, point-of-use surveys, transaction surveys, library effectiveness

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This article is based in part on two presentations: Plum, Franklin, Kyrillidou, Roebuck, and Davis (2008) and Kyrillidou, Plum and Thompson (2009).

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INTRODUCTION

> Of course, librarians have been bleating on about users since time immemorial, but have not really made that much progress in getting closer to them. It is almost as if, by mentioning users, this assuages the guilt. (Nicholas 2008)

Serials are rapidly morphing into networked electronic resources and services. Typically, citation statistics have been the familiar way of judging the quality of a serial and whether a journal is a first-tier publication attracting high-quality work. Many limitations, though, have been identified as usage statistics and impact of a work may not relate directly to citation patterns. Alternative methodologies have been proposed for evaluating serials, especially in their new networked electronic-resource forms. Many of the methodologies rely on usage data from Web servers, but few approaches have emerged where the user directly is being asked about the utility of a resource. This article focuses on adding value to the research, teaching and learning process by implementing point-of-use Web surveys that can be deployed to evaluate the usage and impact of networked electronic resources.

The 2009 *ISSN Manual* defines two types of bibliographic resources that are continuing: those issued in successive parts—serials, also including monographic series and e-journals—and those that are integrating, including such things as updating loose-leafs, databases, and websites. The pertinent definitions, as found in the manual, are as follows:

> **Continuing resource**: A publication, in any medium, that is issued over time with no predetermined conclusion and made available to the public.
>
> Note 1: Such a publication is usually issued in successive or integrating issues which generally have numerical and/or chronological designation.
>
> Note 2: Continuing resources include serials such as newspapers, periodicals, journals, magazines, etc., and ongoing integrating resources such as loose-leaf publications that are continually updated and Web sites that are continually updated.
>
> **Serial**: A continuing resource issued in a succession of discrete issues or parts, usually bearing numbering, that has no predetermined conclusion. Examples: Journals, magazines, electronic journals, ongoing directories, annual reports, newspapers, monographic series, and also those journals, magazines and newsletters of limited duration that otherwise bear all the characteristics of serials (e.g., newsletter of an event).

> **Ongoing integrating resource**: A continuing resource that is added to or changed by means of updates that do not remain discrete and are integrated into the whole. Ongoing integrating resources have no predetermined conclusion. Examples: Databases, Web sites and loose-leafs that are updated over time with no predetermined conclusion. (ISSN Manual, 13)

Clearly, the concept of a serial publication has evolved considerably over time. It has been effectively captured primarily through annual descriptive statistics, like the *ARL Statistics,* in the form of serial subscriptions or cost per subscription (Kyrillidou & Bland 2009)—the latter highlighting for years the well-documented "serial crisis" (Case 2009). New ways of capturing serials are implemented in the *ARL Statistics,* moving us from the concept of subscriptions to titles, but not without challenges in interpretation and implementation (Kyrillidou 2008). Yet even more innovative approaches that are focusing on the user, like point-of-use Web surveys, show even greater promise in being able to capture effectively the value of networked electronic resources toward improved research, teaching, and learning outcomes.

Point-of-use Web surveys can supply valuable data about users and usage of subscription networked electronic resources made available by the library. They are transaction-based surveys typically implemented at the moment a user is downloading a resource. These data complement COUNTER/SUSHI vendor-supplied usage data in helpful ways. For example, while vendor-supplied data can generate cost/use information about the number of views or searches in expensive databases targeted at the academic research community, **point-of-use Web surveys can determine whether funded researchers in fact in their final workproduct directly use these databases, to what extent, and why.** Locally developed point-of-use or intercept surveys are not widely used in libraries, possibly because they are not perceived as simple to implement, and possibly because the sampling plan is not trusted to be a true sample of the population. This article investigates three of these issues:

a. Point-of-use survey implementation methodologies used in libraries.
b. There is a useful review in White and Kamal (2006) of implementation methods. The present article builds on that review, using the MINES for Libraries studies as examples. It explores point-of-use intercept surveys using rewriting proxy servers, OpenURL link resolvers, and scripts.
c. Sampling plans for point-of-use surveys.
d. Point-of-use or intercept or transaction surveys can be administered in several probabilistic ways, including a random-moment sample in which survey times are stratified in some way and chosen randomly, and an every-nth-survey is generated, for example, with every 1:250 or

1:500 resource use. Intercept surveys solve the difficult problem on the web of assuring the sample is randomly chosen.

e. Representativeness of mandatory and optional Web-based intercept surveys—the problem of nonrespondents.
f. One way to address response rates is to make the survey questions required by effectively making the survey mandatory. Mandatory surveys, which require survey completion in order to access resources, are unusual, but are permitted in most academic environments to improve services. The results of mandatory survey can be compared to the results of optional surveys to determine the characteristics of the nonrespondents of optional surveys.

The present article outlines issues with implementation methods, sampling plans, and nonresponse for point-of-use studies of networked electronic resources in libraries. Based on the methods and sampling plans used in a variety of point-of-use surveys presently underway, the article makes recommendations for the survey methodologies and sampling plans that are the best fit for libraries evaluating usage of electronic resources. The recommendations are efficient, sustainable, realistic, and inexpensive.

LITERATURE REVIEW OF METHODS FOR EVALUATING SERIALS USAGE

This review of the literature looks at different aspects of serial usage data collected remotely and locally. These methods of usage data collection are then compared to the locally implemented Web-based sampling methods later in the article.

A useful review of methods for determining core journals is found in Nisonger (2007), in which he surveys ten different methods: subjective judgment by experts, usage, coverage by indexing and abstracting services, overlapping library holdings, citation or bibliometric data, citation network or co-citation analysis, production of articles, Bradford's Law, local faculty publication data, and multiple criteria methods. Citation data are broken down into three subsets: the total citation count in a set of source documents, coverage in *Journal Citation Reports* or journal impact factor, and the discipline impact factor. As defined by Cross (2009), the journal impact factor is, "At the simplest level, journal impact factors give the average number of citations to articles in a particular journal; essentially, the average number of times that articles in a journal are referenced by other articles." Cross goes on to give a helpful overview of impact factors, particularly their limitations. For example, smaller journals have more variable impact factors than larger journals.

One productive approach to assessing the impact of digital content is through census counts such as the statistics of usage of networked electronic resources collected by external vendors conforming to codes of practice, like COUNTER (Counting Online Usage of Networked Electronic Resources, http://www.projectcounter.org/) and standards-based expressions of them such as SUSHI (Standardized Usage Statistics Harvesting Initiative, http://www.niso.org/workrooms/sushi), a standardized transfer protocol defined by National Information Standards Organization (NISO) for COUNTER compliant statistics. The constantly updated Codes of Practice (http://www.projectcounter.org/code_practice.html) recommend that vendors produce a number of library-use reports, such as the "Number of Successful Full-Text Article Requests by Month and Journal," "Turnaways by Month and Journal," and "Total Searches and Sessions by Month and Database." The SUSHI standard (NISO Z39.93–2007) has three supporting XML schemas posted to the NISO website and are retrieval envelopes for the conforming XML-formatted COUNTER reports. These data are analyzed by libraries, either by moving the data into electronic resource management systems (ERMS) or by creating spreadsheets. The purpose of the analysis is often to generate cost-per-use data. Although the calculation is simple, collecting meaningful cost data from the complex bundling offered by vendors is not trivial, but it is becoming easier.

COUNTER is a useful step forward, but not the total solution for assessing usage data. Baker and Read (2008) surveyed academic librarians to determine how much effort is required to process the COUNTER data, how the data are used, and what data are the most meaningful. This survey is part of the MaxData project "Maximizing Library Investments in Digital Collections Through Better Data Gathering and Analysis," an Institute of Museum and Library Services-funded project from 2004–2007 in which three research teams studied different types of usage data for electronic resources and developed a cost-benefit model to help librarians "determine how best to capture, analyze and interpret usage data for their electronic resources" (Baker & Read 2008, 49). They found that librarians still wrestle with inconsistent data, both from COUNTER non-compliant vendor reports, but also within COUNTER-compliant reports. In general, the census data supplied by vendors external to the library are useful for cost-use studies, although Conyers and Dalton (2007) provide evidence that this analysis is more difficult than it appears. Combining these data with locally generated Web logs or other user-survey data will help analyze user behavior and motivation.

One popular analysis system for analyzing vendor reports is ScholarlyStats (https://www.scholarlystats.com/sstats/default.htm). ScholarlyStats is an online portal for journal- and database-usage statistics. It collects monthly usage data from journals and databases, and it claims reports of usage data from almost 400,000 e-journals. The reports are standardized, consolidated,

and can be displayed in a dashboard of graphs and reports. The data can integrate with various electronic resource management systems through SUSHI. Electronic resource management systems can collect usage data from various vendors, but the formats of the reports often differ. The ERMS then produce their own reports of commensurable data from different vendors. An example of a library that has integrated the Innovative Interfaces, Inc. ERM, SUSHI, and ScholarStats is Washington State University (Chisman 2008).

There are even efforts to explore the viability of developing usage reports for individual articles by combining data gathered from publishers, aggregators, and institutional repositories. The COUNTER-led Publisher and Institutional Repository Usage Statistics (PIRUS) project is described by Gedye (2009). It maps a plan to identify relevant source items, to look at how to collect data about the usage of these items, and then to collate and display the data in an appropriate form (Geyde 2008, 26). Another effort along the same lines is bringing the analytical methodology of the citation impact factor to bear on usage as measured in downloads in an effort to develop usage impact factors. Data on the number of downloads of articles in e-journals form the basis of the proposed usage factor (Bollen & Sompel 2008; Shepherd 2007). This usage factor could be applied to journals (although one could possibly extend it to authors, institutions, and countries), and would be computed in the same way as the journal impact factor based on citations. The usage factor for an individual journal would be the total usage over period X of items published in period Y (for example, COUNTER JR1 data for a specific period) divided by the total items published online during period Y (total number of articles published in the online journal for a specific period). Bannerman (2008) summarized this proposal and discussed its strengths and weaknesses. Other studies on e-metrics and the assessment of the usage of journals are cited in the thorough literature review of Kinman (2009).

Another technique for measuring journal usage is deep log analysis (DPA). A useful summary of deep log analysis is provided by Nicholas (2008) in the United Kingdom Serials Group's *E-Resources Management Handbook*, by Nicholas et al. (2009), and by Nicholas et al. (2005). DPA enriches Web log data with user demographic data, drawing from a user database or online questionnaires. These data are collected locally, in contrast with COUNTER data, which are collected remotely. Because log files provide little explanation of behavior, deep log analysis follows up with a survey or with interviews. DPA was developed by the Centre for Information Behaviour and the Evaluation of Research (CIBER) (http://www.ucl.ac.uk/ciber/). The DPA technique is employed with OhioLINK and is part of the MaxData project. The technique is attempting to provide methods for obtaining good quality usage data through transaction logs, with items used, viewed, or requested counted as use.

WEB SURVEYS

The most popular current method of measuring usage of electronic resources by libraries is not through Web-based usage surveys, but through vendor-supplied data of library patron usage or transaction usage. Yet, Web-based usage surveys are increasingly relevant in the gathering of usage data to make collection development and service decisions, to document evidence of usage by certain patron populations, and to collect and analyze performance outputs.

Although there is solid literature on use and user library surveys (Covey 2002; Rowlands 2007; Tenopir 2003) some of which are Web based (Bertot 2009; Cook, Heath, & Thompson 2000; Couper 2008; Couper, Traugott, & Lamias 2001), there is little literature on point-of-use or intercept surveys for networked electronic resources in libraries. A valuable literature survey regarding the collection of usage data for networked resources at the local library level is found in White and Kamal (2006, 129). Locally developed census counts are generated from click-through scripts, rewriting proxy server logs, Virtual Private Networks (VPNs), or OpenURL server logs, or other methods to capture data of networked electronic resource usage at the local level. White and Kamal also present some creative models of the network infrastructure necessary to collect these data locally, including electronic resource management systems (99), VPNs (108), and rewriting proxy servers (109).

Most Web surveys are nonprobability-based samples, and therefore not open to inferential statistical statements about the populations. Large sample sizes do not compensate for a low response rate or a non-representativeness, or both. The nonresponse rate for most Web surveys is high, and may introduce bias. Web surveys have in the past been used to collect data about users, or about sessions, but not about usage. Therefore, the data they collect cannot be related to the usage data collected by vendors of networked electronic resources. Web surveys, because they focus on users, are often collections of impressions or opinions, not of more concrete actual usage, and are therefore not trusted to yield reliable data that can be compared longitudinally. They are often not based on actual, point-of-use usage, but upon predicted, intended, or remembered use, introducing error. Web surveys may not appear consistently when viewed in different browsers, thus affecting the results in unanticipated ways. One of the usual criticisms about Web surveys focuses on the digital divide: users may have unequal access to the Internet and as a result Web surveys introduce coverage error (Franklin & Plum 2006; Gunn 2002).

Among the many issues with Web surveys, the distinguishing factors the present article examines are methodologies for intercept surveys, randomized sampling plans for Web surveys, and the representativeness of mandatory surveys, in relation to response rates. For example, Kaczmirek and Neubarth (2005) recognized the problems with popup surveys as browsers make increased use of popup blockers, and as respondents become much less enthusiastic about impositions on their time, and suggest

the importance of a different methodology. The links are caught by a script. The survey invitation page is presented to the user after the user clicks on the link. Either an action of the user or a timeout leads to the survey or the formerly chosen destination page. The user completes or abandons the survey, and the browser then goes to the formerly chosen target page.

In an early article on Web surveys, Couper (2000) noted that coverage error is the biggest threat to Web surveys (467). Coverage error is the mismatch between target and frame populations. In a survey of academic library networked electronic resources, coverage error is less of a problem. The frame population is the students, faculty, and staff of the university who wish to use a networked electronic resource. The frame is more inclusive than visitors to the library website, depending on how the survey is implemented. Networked electronic resources require authentication, so a point-of-use survey at the resource is less likely to attract users outside of the frame. If the users are asked a question about classification (student, faculty, staff, or other), then the "other" responses can be treated differently during data analysis. Digital collections open to all might attract interest from outside the frame, that is, from users not associated with the university, but these respondents can be identified by self-classification and the target Uniform Resource Locator (URL), or the URL of the digital collection that the users were intending to search.

Couper identified two main problems with intercept surveys: timing and nonresponse (485). For the MINES protocol, the user is invited to complete the survey upon arrival at a networked electronic resource or service. This timing is valid because the user's use of the resource is the goal, not the outcome of that use. Nonresponse is a trickier problem. In a survey of library and information science surveys, Burkell examined nonresponse rates in three major Library and Information Science (LIS) journals. She arbitrarily placed an almost impossibly high rate of response necessary for generalizability, 75%, and then noted that in these three journals the response rate ranges from 58.8% to 67.5%. These surveys are in general not Web surveys. Any researcher using Web surveys would be thrilled to achieve such high response rates. She stated, "The question, therefore, is not whether nonresponse has resulted in a biased sample: that answer is always 'yes.' The important issue is whether the bias influences survey results." LibQUAL+ and MINES for Libraries have different answers for the problem of nonrespondents: LibQUAL+ depends on estimates of representativeness, and MINES uses point-of-use interception with *required* responses.

WHAT IS MINES FOR LIBRARIES?

MINES for Libraries® is part of the StatsQUAL suite of assessment tools that operates under the leadership of the Association of Research Libraries. StatsQUAL® (http://www.statsqual.org/) is a mature statistical gateway for

assessment tools for the library community. In addition to MINES for Libraries, it now includes the following data services:

- *ARL Statistics*®, a series of annual publications that describe the collections, expenditures, staffing and service activities for ARL member libraries;
- LibQUAL+®, a rigorously tested web-based survey that libraries use to solicit, track, understand, and act upon users' opinions of service quality;
- DigiQUAL®, a development project for modifying and repurposing the existing LibQUAL+® protocol to assess the services provided by digital libraries; and
- ClimateQUAL®, Organizational Climate and Diversity Assessment, that measures staff perceptions about the library's commitment to diversity, organizational policies, and staff attitudes.

These tools help to describe the role, character, and impact of physical and digital libraries on teaching, learning, and research. The StatsQUAL system allows for the presentation of these tools in a single interactive framework that integrates and enhances data mining and presentation both within and across institutions.

The MINES methodology deepens the institutional understanding of the COUNTER/SUSHI data, and addresses some of the weaknesses of Web-based surveys. Most sample counts are user studies, but are not linked directly to particular usage events, nor are the results comparable across peer institutions. Tenopir (2003), updated by Rowlands (2007), surveyed user studies. One difference between the MINES approach and many of the other Web-based user surveys recounted in Tenopir and Rowlands is the emphasis on usage. Although user demographic information is collected, MINES is a Web survey focusing on usage rather than users. The respondent must choose the Web-based networked electronic resource in order to be presented with the survey, and therefore memory or impression management errors are prevented. Only once the survey is completed, the respondent's browser then is forwarded to the desired networked electronic resource. This approach is based on the random-moments sampling technique. Each survey period is at least two hours per month, so each survey period in itself is only a snapshot of usage. Because the survey periods are randomly chosen over the course of a year and result in at least twenty-four hours of surveying, the total of the survey periods represents a random sample, and inferences about the population are statistically valid with a 95% confidence level and a low standard error (e.g., less than 2%). The MINES methodology is action research, historically rooted in indirect cost studies. It is a

- set of recommendations for research design
- set of recommendations for Web survey presentation

- set of recommendations for information architecture in libraries
- set of validated quality checks. (Franklin & Plum 2006)

If scaled, this approach can serve as the basis for a plan for continual assessment of networked electronic resources, and an opportunity to benchmark across libraries. It can be implemented independently or possibly in conjunction with the calculation of related usage impact factors given the appropriate underlying architecture for capturing data.

MINES has been administered at 50 North American libraries in the last five years through locally implemented indirect cost studies. More than 100,000 networked services uses have been surveyed at those 50 universities since 2003 (Franklin & Plum 2008, 2006, 2004, 2002). Under the aegis of Association of Research Libraries (ARL), the protocol has been administered at the Ontario Council of University Libraries, where the study will be repeated and expanded in 2010. It has also been done at the University of Iowa, Iowa City (Kyrillidou, Roebuck, & Davis 2009), and the University of Macedonia (Kyrillidou, Roebuck, & Davis 2008). A similar non-ARL study was done on the OhioLINK resources (Connell, Rogers, & Diedrichs 2005).

MINES has followed the Web survey design guidelines recommended by Dillman, Smyth and Christian (2008), which suggests a number of principles for the design of Web surveys to mitigate the traditional sources of Web survey error: sampling, coverage, measurement, and nonresponse. To reduce the effects on the responses of different renderings of the survey by different workstation browsers, the survey uses simple text for its questions. The survey is short, with only a few questions, easy to navigate, and plain. Questions are presented consistently, that is, with either radio buttons or drop-down menus. A short paragraph explains the purpose of the survey, with institutional review board contact information, if required. Figure 1 presents an example of the Web survey, following Dillman's recommendations.

The MINES methodology also recommends a library Web architecture or a gateway in order to be certain that all respondents in the sample period are surveyed, and that Web pages other than the library website, bookmarks, short cuts, and other links all go through a central point. This networked assessment infrastructure is discussed in Franklin and Plum (2006), and has included rewriting proxy servers, OpenURL servers, federated searching, database-to-Web scripts for generating links, digital libraries, authentication systems, electronic resource management systems, and other gateways. Based on this network assessment infrastructure, the intercept points for the Web survey include:

- e-books (tricky because citations and links to e-books are found both within the catalog and within specialized databases)
- e-journals (at the ERM or OpenURL link resolver)

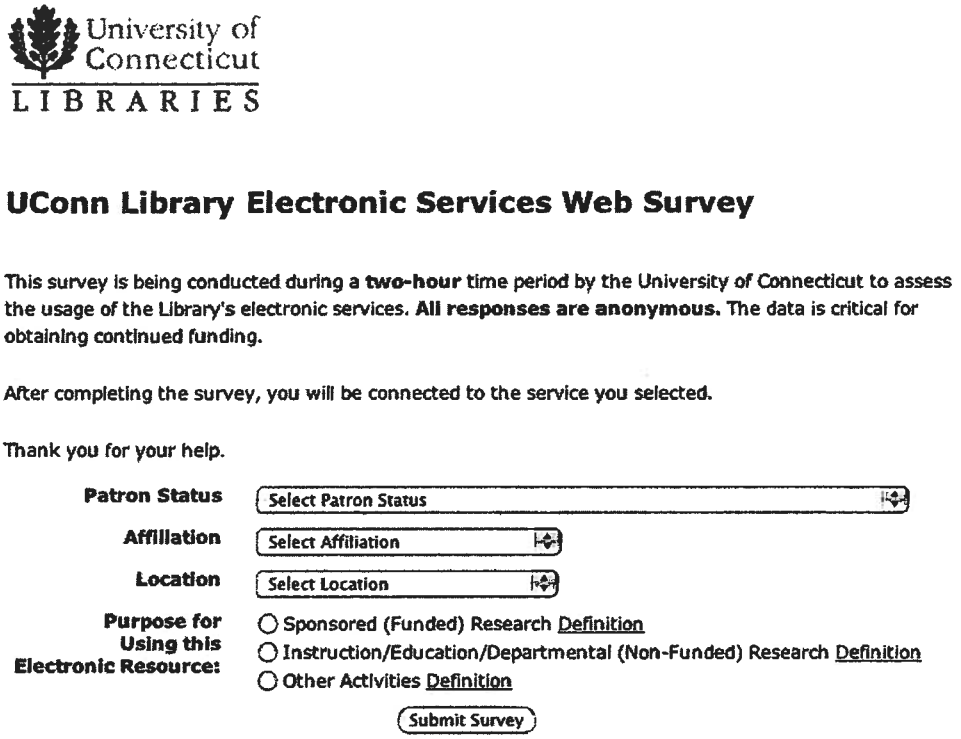

FIGURE 1 MINES for Libraries survey as implemented at the University of Connecticut.

- Databases
- Online catalog
- 856 field links out of the online catalog (if the links go through the intercept or choke point)
- Interlibrary loan
- Ask a Librarian (virtual reference)
- Digital collections
- Electronic course reserves (sometimes omitted because it is assumed to be used by undergraduates for instruction)

MINES has a number of quality markers built into its implementation. The target population is the population frame, in that the protocol surveys the patrons who are intended to be surveyed, except in libraries with popular open digital collections. Usage is checked against IP or session ID to make certain that the survey is not tracking responses too promiscuously. The order of the questions is changed over time, particularly with the purpose of use. Workstation IPs are spot-checked against self-identified location. For the purpose-of-use questions, responses of undergraduates choosing sponsored research are spot checked to make

certain that the undergraduate understood the question, thus mitigating measurement error. Sometimes all undergraduate sponsored research responses are mapped back to instruction, depending on the mission of the institution. For sponsored-research responses, there is an open-ended validity question asking for the name of the principal investigator, granting agency, name of the grant or some other piece of information about the grant to ascertain that the definition of sponsored research is being understood correctly. There are also discussions with the local librarians and pre-testing at every university to increase content validity. Finally, in some networked environments, turn-aways or the number of patrons who elected not to fill out the survey are tracked as a measure of nonresponse.

There are three types of nonrespondents to the point-of-use Web survey in the library.

1. There are nonrespondents who do not see the survey. One of the potential failings of the point-of-use survey is the inability to capture all usage. Some patrons bookmark around the library's databases of e-journals and databases. Some patrons use Google Scholar to find institutional repository copies of versions of the known article. Some network infrastructures can only intercept the off-campus user, but not the legitimate, within-IP user. Some databases, although many fewer than in the past, require a specialized client on the workstation with a password, which is difficult to intercept.
2. Nonrespondents may see the survey but choose not to respond. It is difficult to assume representativeness among nonrespondents, although in LibQUAL+, Thompson (2000) argues that representativeness can be determined and is more important than response rate. As will be seen in the case study described here, the MINES solution is to make all four of the questions on the survey required, that is, to present a mandatory survey. As might be imagined, this aspect of the protocol is controversial. In a case study implementation, we explored mandatory and optional results to see if the samples are the same. Most users fill out the survey to get to the resource.
3. Under the two-hour survey sampling plan, the MINES Web survey protocol is interested in capturing subsequent uses of the databases or e-journals after the survey is initially filled out by the user. Therefore, the Web survey should set up a session with a session ID to track subsequent uses of surveyed resources (typically e-journals and database) during the survey period, and write the values from the completed survey to subsequent uses for that patron. Usually the session ID is tied to the browser session. So the session ID would track the values of the first survey and all subsequent uses by the user during the surveyed period. The session is often established with a cookie. The patron sees and completes the survey

only once. Figure 2 presents an example of the MINES raw data file using session IDs.

Note that the session IDs for several records are the same (as are the IP addresses, which have been made anonymous), but the target URLs triggering the survey are different. The values from the subsequent URLs within a session are mapped from the results of the initial survey that the user filled out. The COUNTER Code of Practice for Journals and Databases, Release 3 (http://www.projectcounter.org/code_practice.html) uses the NISO definition of a session:

> A successful request of an online service. It is one cycle of user activities that typically starts when a user connects to the service or database and ends by terminating activity that is either explicit (by leaving the service through exit or logout) or implicit (timeout due to user inactivity). (http://www.niso.org/dictionary/appendices/appendixa)

At the local administration of the Web survey, the session is equated to the browser session, in part to reduce the likelihood that the patron would have to fill out the survey again. Federated searching or searching of multiple databases is treated differently depending on the interception point. Conceptually, the federated search is regarded as a search engine, not as a large heterogeneous database. The results of the first survey are written to the capture database every time the user's browser calls up a different surveyed domain.

Some libraries have been brave enough to change globally a couple hundred thousand 856 links (explained at http://www.loc.gov/marc/856guide.html) to point to the survey intercept point. Some libraries already point their 856 links for journals to their electronic records management environment, which is a better solution. So, for example, if SFX is being used for e-journal titles, the SFX server is part of the 856 URL. Some libraries using a proxy rewriter already have the survey point, the proxy server prefix or suffix, in their URL. Other libraries ignore access to the e-journals through the catalog, even though the 856 fields are faithfully populated. They offer better means to the e-journals through some other e-journal presentation, so that the catalog is not used. However, with e-books, the 856 is quite important. In many academic libraries up to 10% of the holdings are e-books, a data point that can be easily demonstrated by a search.

POINT-OF-USE WEB SURVEY IMPLEMENTATION METHODOLOGIES USED IN LIBRARIES

As discussed earlier the protocol implementation requires an assessment infrastructure at the network level, which may not be easily implemented if

RecordID	SessionID	Date/Time	IP	Classificatior	Affiliation	Location	Purpose	Fund Sourc	Target URL
41561	198623A9D4D1898FAE3656E869E68BD5	10/2/09 14:41	192.168.0.168	grad	Engineering	Off Campus	funded_resear	DOE	http://dx.doi.org/10.1115/1.2838032?nosfx
41763	198623A9D4D1898FAE3656E869E68BD5	10/2/09 15:10	192.168.0.168	grad	Engineering	Off Campus	funded_resear	DOE	http://linkinghub.elsevier.com/retrieve/cook
41767	19A5141EB0B00673807985056 4A40D58	10/2/09 15:11	169.254.1.112	grad	Arts&Sciences	In Library	non_funded		http://www.csa.com/htbin/dbrng.cgi?userna
41931	19AD73E44EA582E023048A895437DD39	10/2/09 15:35	169.254.1.22	faculty	Arts&Sciences	In Library	funded_research		http://springerlink.metapress.com/openurl.a
41576	1A9693197FB3DED862E019866D169168	10/2/09 14:44	169.254.1.22	faculty	Engineering	In Library	other_activities		http://isiknowledge.com/wos
41587	1A9693197FB3DED862E019866D169168	10/2/09 14:46	169.254.1.22	faculty	Engineering	In Library	other_activities		http://dx.doi.org/10.1038/78929?nosfx=y
41637	1A9693197FB3DED862E019866D169168	10/2/09 14:52	169.254.1.22	faculty	Engineering	In Library	other_activities		http://linkinghub.elsevier.com/retrieve/cook
41651	1A9693197FB3DED862E019866D169168	10/2/09 14:54	169.254.1.22	faculty	Engineering	In Library	other_activities		http://linkinghub.elsevier.com/retrieve/cook
41488	1C1E83FBC7CBDB1579F36565839713E8	10/2/09 14:29	169.254.1.202	grad	Engineering	In Library	non_funded		http://isiknowledge.com/wos
41303	1CC10488FACDAF8A3C9BE806094F57C5	10/2/09 13:57	169.254.1.109	faculty	Arts&Sciences	In Library	non_funded		http://isiknowledge.com/wos
41612	1CC10488FACDAF8A3C9BE806094F57C5	10/2/09 14:49	169.254.1.109	undergrad	Arts&Sciences	In Library	non_funded		http://links.jstor.org/sici?origin=sfx%3Asfx&
41461	1CC10488FACDAF8A3C9BE806094F57C5	10/2/09 14:22	169.254.1.109	undergrad	Arts&Sciences	In Library	other_activities		http://linkinghub.elsevier.com/retrieve/cook

FIGURE 2 Example of the MINES for Libraries raw data file using session IDs.

the needed network and systems expertise is not available. Because each solution must be implemented locally to enable the point of use survey, only libraries or consortia with strong IT departments have succeeded with MINES.

Table 1 lists the various Web-based surveys implemented using the MINES protocol over the last two years. Note that the solutions fall into several main categories: the rewriting proxy server (usually EZproxy), OpenURL (usually SFX), or a script that either generates links to databases or e-journals, or that is placed in front of these links for local statistics or IP checking. The bolded technology is the primary method to implement the survey. The digital collections are listed only if surveyed. The last entry, dated 2010, is the second Ontario Council of University Libraries study, with 21 universities participating. This illustrative study used an every-nth sampling plan, described in the following section, and therefore does not need the session ID data point.

Table 1 shows that it is possible to implement the intercept survey at different points in network assessment infrastructure, as long as it is done with the intent of trying to capture the maximum usage. A certain leakage is inevitable, and it may be growing with open access. The open access movement will probably increase the percentage of nonrespondents who are using scholarly resources but not going through the library. The problem can be mitigated by aggressive efforts to integrate open-access scholarly resources into the library's presentation and responsibility. Although including the *Directory of Open Access Journals* database in the library's ERM or OpenURL link resolver is a start, libraries should take responsibility for much more, not only because doing so will reduce the percentage of nonrespondents who are using scholarly resources and do not see the survey, but primarily because service to the patrons improves.

Table 1 also shows that as long as the data are reported as percentages and not as raw numbers, the results are commensurable between institutions regardless of the survey implementation methodology. These Web survey studies have been done since 2000, and validation is also ascertained by comparing actual results against expected results. The data from these studies show consistency within each institution and are what we would expect to find across institutions. There are many factors that could influence the results, such as size of the undergraduate population, information literacy programs, the level of research that the university supports as measured by its research funding base per year, the ratio of faculty to undergraduates, and so on. These factors are reflected in the results in the different implementations.

One validity check to the implementation methods was done in 2007 (not on the chart) where the MINES protocol was implemented at the Internet service provider's Cisco router, the router for the entire campus of a top-tier research institution. The network administrator implemented the Web

TABLE 1 MINES for Libraries Usage Surveys Initiated or Ongoing in 2008–2010

Date	University library	Session ID	OpenURL	ERM A–Z Journals	EZproxy	Link generating script
2008	West coast public academic	yes			**yes**	
2008	Mountain states public academic	no	**WebBridge**	Local		**ColdFusion**
2008	West coast public academic	yes		**Local**		**ColdFusion**
2008	New England public academic	yes	**SFX**	Local		**ColdFusion**
2008	Mid Atlantic public academic health sciences	yes	SFX	Serials Solutions		**JavaScript**
2008	New England public academic	no	SFX	SFX	yes	**ASP**
2008	South public academic health sciences	no		Ebsco A-Z		**php**
2008	Midwest private academic	yes	SFX	Serials Solutions	**yes**	**JavaScript**
2009	Mid Atlantic public university	yes	SFX	SFC	**yes**	**Php script and EZproxy server**
2009	West coast public academic	yes	SFX (consortial)	Local ERM	no	**Php script**
2009	Southwest public academic	yes	SFX	Local ERM	**yes**	**Php script**
2010	North consortia of university libraries— OCUL	No— every nth	**SFX**	**SFX**	yes	Limesurvey

Note: The boldface applications are the primary method used to implement the intercept survey.

Cache Communications Protocol (WCCP), which was designed to reduce traffic and the amount of time required to download Web files. It involved a redirection to the Cisco Cache Engine, which was based on the requested domain, compared to a table of library resource IPs. In this case, the browser request was redirected to the library survey server, where the survey was presented and a cookie placed on the browser workstation. With this implementation strategy, every request for any library resource was surveyed with a mandatory survey. Any activity originating from within the university, including bookmarks and links from departmental Web pages, was surveyed. The distribution of the results was in line with what was expected, and consistent with other implementation strategies that were less inclusive. This instance became a validity check for other methods of implementation. Based on inspection and experience, the different implementation methods do not seem to unduly bias the results.

A systems analysis approach for organizing and implementing networked electronic resources, with a rational topology of paths to resources, results in surveys that have fewer nonrespondents, and gives the library better information. If there is a gateway or chokepoint in the network assessment infrastructure, libraries have a much better idea of what their users are doing with the digital services and resources, either through transaction logs or by administering a Web survey.

POINT-OF-USE SURVEYS SAMPLING PLANS

With point-of-use surveys several sampling methods for assessing the usage of networked electronic services and resources may be employed, which permit libraries and consortia to make valid and reliable inferences about their user populations. The MINES sampling plan is well documented (Franklin & Plum 2006, 2004, 2002). In brief, it typically takes place over two hours per month over the course of a year; the two-hour interval is randomly selected from all the potential two-hour intervals available in a month. One of the strengths of MINES is the true inferential quality of the results—the survey is based on a random moment sample, and develops a valid and reliable sample of the population of all possible survey times.

However, other sampling plans are also possible. One was used at the University of Macedonia, and the period of investigation was three months. In this case the sampling plan included a two-hour randomly chosen period on a daily basis, and the study collected over 2,800 completed surveys (Kyrillidou, Roebuck, & Davis 2008). The University of Macedonia implementation was done on Linux with CentOS 4.6 using PHP scripting on Apache 2.0 Web servers and the data were stored in MySQL 5.0.62. To redirect the user to the survey the Apache Rewrite Engine was used, rewriting the original destination without losing the information so once users filled

in the survey they could be redirected to their original target URL (Alvanoudi, Kolovos, & Kyrillidou 2008).

A third sampling plan is under development now at the Ontario Council of University Libraries (OCUL). The OCUL study is the second ARL study done at this consortium, but with a different sampling plan. The results of the first study were reported at Northumbria in 2005 (Kyrillidou et al. 2005). This second study, planned for 2010, will use an every-nth sampling plan. If the survey is mandatory, then 1:1,000 is sufficient for a large university like the University of Toronto. If the survey is optional, then an n of 1:500 or even less is necessary. The survey is implemented with an iteration of limesurvey, and each of the 21 universities in OCUL will have its own limesurvey and sampling plan. Smaller universities with less usage may have a sampling plan of 1:250 to produce sufficient data to be of value to the institution. OCUL-wide comparisons can be calculated based on the ratio of n for each institution. This approach has been tested and is scheduled to move into production in 2010.

The every-nth approach also obviates the necessity for session IDs. The survey is administered at a randomly chosen time at the SFX service within the designated range for n, that is, 1:250, 1:500 or perhaps 1:1000. The every-nth survey is implemented only once and does not have a session ID because it does not track sessions. Session IDs are sometimes difficult to set up, and thus an every-nth sampling plan may be easier to implement. It also does not track users within a session, an ethical consideration. As the range for n chances to be surveyed becomes smaller, less than 1:250, the likelihood that frequent users of the e-journals will be surveyed more often will increase. This more frequent surveying of frequent users is not conceptually different from tracking users in a session who may look at five or ten resources.

In testing the every nth approach at the University of Toronto earlier in 2009, we wanted to see how results compared to the random-moment sampling plan they implemented in 2005. We extracted three months of preliminary University of Toronto data from 2005 under the random-moment sampling plan, and compared these data to those from the 2009 every-nth sampling plan. Table 2 and Figure 3 summarize the data from the two methods. These data are exploratory. However, there are some large differences, particularly with sponsored research, that may be either due to the passage of time between studies or to differences between the session and the every-nth sampling approaches.

MANDATORY VERSUS OPTIONAL: THE PROBLEM OF NONRESPONDENTS

In her article "The Dilemma of Nonresponse," Burkell (2003) noted that "This is the central dilemma of nonresponse: the impact of nonresponse on survey data cannot be determined without data (either actual or estimated)

TABLE 2 Comparison of 2005 Session Data to 2009 Every Nth Data by Purpose of Use: MINES for Libraries at the University of Toronto

Purpose	2004/5		2009	
Coursework	443	37.8%	711	43.8%
Other Research	183	15.6%	280	17.3%
Other Activities	60	5.1%	110	6.8%
Patient Care	43	3.7%	78	4.8%
Sponsored	381	32.5%	359	22.1%
Teaching	63	5.4%	84	5.2%
TOTAL	1173	58.5%	1622	100.0%
None	175	14.9%	40	2.5%

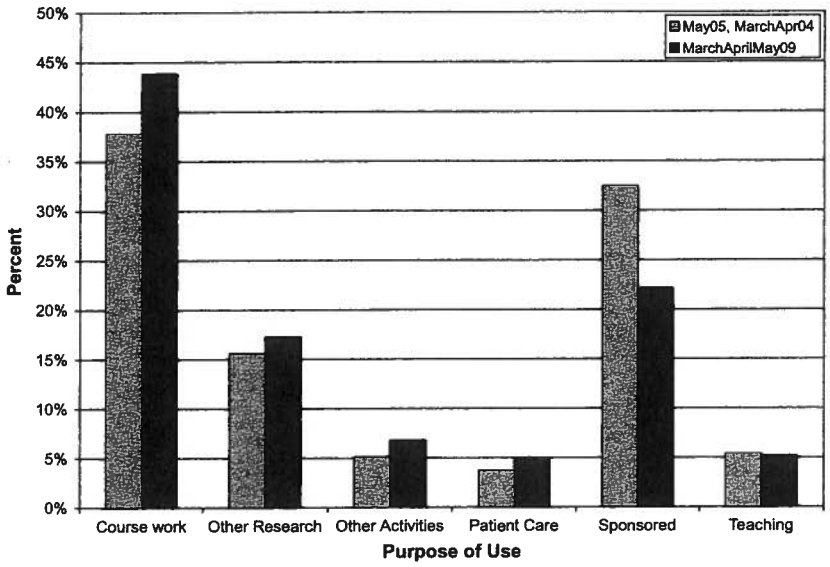

FIGURE 3 Comparison of 2005 session data to 2009 every nth data by purpose of use: MINES for libraries at the University of Toronto.

from nonrespondents." MINES has preliminary data that can estimate nonrespondents in a Web-based survey. For five months in 2005 at the University of Connecticut, two two-hour MINES Web-based surveys per month were administered; one was mandatory and one was optional. Data were collected for mandatory and optional, but data were also collected on the optional nonrespondents, that is, those users who clicked through the survey without filling it out. It is unusual to have a count of nonrespondents, which is why, in the tables that follow, there are three sets of numbers presented: mandatory, optional with nonrespondents included, and the more typical optional with nonrespondents excluded (usually because there is no count of the nonrespondents). In general, the 28% nonresponse rate on the

purpose of use is surprisingly low; it is even slightly less for the user group (18.5%) and location (21.6%) variables.

There are clear differences in the respondents between mandatory and optional. Under purpose of use, instruction is a higher percentage of optional responses than mandatory, and sponsored research is a lower percentage (Table 3). Under classification, faculty participation goes down, and interestingly both the raw score and the percentage of undergraduate participation increases (Table 4). For location, some respondents are lost from the in-library location category when they are faced with the optional version (Table 5). The data are analyzed using Cramer's V squared, which shows that there is a difference and the effect is small. The mandatory and optional surveys were given each in the same month, at randomly chosen dates and times, so there is no chronological or maturation error. Interestingly the sample sizes (n) are similar.

Which is the true picture of usage? Mandatory may not be a true picture of the population and optional may not be a true picture either. The optional versus mandatory dichotomy may result in different kinds of nonresponse bias. This very preliminary study is the only one we know of that

TABLE 3 Comparison of Mandatory and Optional Protocol by Purpose of Use: MINES for Libraries Exploratory Study at the University of Connecticut (January–May 2005)

Purpose	Mandatory		Optional+none		% Diff	Optional-none		% Diff
Instruction	1167	59.3%	923	46.3%	13.04	923	65.4%	–6.09
Other	486	24.7%	327	16.4%	8.31	327	23.2%	1.53
Sponsored Research	314	16.0%	161	8.1%	7.89	161	11.4%	4.55
No Purpose	0	0.0%	21	1.1%	–1.05	0	0.0%	
None	0	0.0%	562	28.2%	–28.18	0	0.0%	
TOTAL	1967	100.0%	1994	100.0%		1411	100.0%	
Cramer's V	0.418							
Squared Cramer's V	0.17472							

TABLE 4 Comparison of Mandatory and Optional Protocol by User Group: MINES for Libraries Exploratory Study at the University of Connecticut (January–May 2005)

User group	Mandatory		Optional+none		% Diff	Optional-none		% Diff
Faculty	340	17.3%	174	8.7%	8.56	174	10.7%	10.7%
Graduate Student	676	34.4%	528	26.5%	7.89	528	32.5%	32.5%
Post-Doc	36	1.8%	21	1.1%	0.78	21	1.3%	1.3%
Staff	223	11.3%	154	7.7%	3.61	154	9.5%	9.5%
Undergraduate Student	515	26.2%	661	33.1%	–6.97	661	40.7%	40.7%
Non-UConn	177	9.0%	85	4.3%	4.74	85	5.2%	5.2%
No Classification	0	0.0%	3	0.2%	–0.15	0	0.0%	0.0%
None	0	0.0%	368	18.5%		0	0.0%	0.0%
TOTAL	1967	100.0%	1994	100.0%		1623	100.0%	
Cramer's V	0.359							
Squared Cramer's V	0.12888							

TABLE 5 Comparison of Mandatory and Optional Protocol by Location: MINES for Libraries Exploratory Study at the University of Connecticut (January–May 2005)

Location	Mandatory		Optional+none		% Diff	Optional-none		% Diff
In Library	390	19.8%	264	13.2%	6.59	264	16.9%	2.93
Storrs	952	48.4%	718	36.0%	12.39	718	46.0%	2.43
Regional	167	8.5%	184	9.2%	–0.74	184	11.8%	–3.29
Off Campus	458	23.3%	396	19.9%	3.42	396	25.4%	–2.07
No Location	0	0.0%	2	0.1%	–0.10	0	0.0%	0.00
None	0	0.0%	430	21.6%	–21.56	0	0.0%	0.00
TOTAL	1967	100.0%	1994	100.0%		1562	100.0%	
Cramer's V	0.353							
Squared Cramer's V	0.12461							

attempts to examine the nonrespondents and the effect of the nonrespondent bias by comparing mandatory and optional web survey protocols.

A more systematic experimental study should be done to study the effects between mandatory and optional. One is being planned as part of the 2010 OCUL implementation of the MINES for Libraries evaluation. The OCUL libraries that are permitted by their institutional review boards to run a mandatory study will run simultaneous mandatory and optional surveys on a randomized, every-nth, schedule. Other libraries that have been told by their ethics review board to run an optional protocol will offer the survey only as optional. This research design has two purposes: to analyze the differences between mandatory and optional results in a systematic way and to be able to compare the 2010 study that has some libraries using the optional protocol with the 2005 study that only used the mandatory protocol. By analyzing the bias introduced by nonrespondents, our goal is to develop a method that would normalize the nonrespondent effects between the mandatory and optional Web survey protocols. The University of Connecticut data and the preliminary results from OCUL lead us to believe that such normalization and adjustments are possible to calculate. In the long run, it may be possible to adjust survey nonresponse bias in primarily optional protocols with only a small percentage of mandatory surveys required to calibrate the nonresponse bias adjustment.

PRACTICAL IMPLICATIONS

In trying to understand the impact of networked electronic resources, libraries need to capture maximum use of these resources even though leakage will be inevitable Ultimately, the more open and flexible the environment for discovery and delivery of networked electronic resources, the more difficult it is to have a good sense of the effectiveness of the use of these services. Libraries can play a major role in taking responsibility for the

evaluation of networked electronic resources for service improvement purposes and will have to grabble with the right balance between assumptions regarding user behavior and implementing data driven service improvement strategies.

The present article has surveyed some usage-based measures for serials and networked electronic resources based primarily on COUNTER data from vendors. It then suggested that point-of-use intercept or transaction surveys also have a role in learning about the users. The present explored three issues with intercept surveys:

1. Point-of-use survey implementation methodologies used in libraries.
2. Sampling plans for point-of-use surveys.
3. Nonresponse bias in mandatory and optional Web-based intercept survey.

Based on the methods and sampling plans used in the MINES for Libraries point-of-use surveys presently underway, we recommend evaluation methodologies, Web survey protocols, sampling plans, and nonrespondent treatment that are the best fit for individual libraries.

Understanding the value networked electronic resources and services bring to the research, teaching and learning experience is a complex issue. Multiple methods and approaches need to be employed, and many unanswered questions still remain. We have a good basis of experience, though, and success in demonstrating that libraries can listen and respond to the needs of their users with thoughtful and caring professional approaches. Library users trust in the library brand and respond to the sharing of knowledge and information by providing useful information through their clickstreams, their personal time, effort, and feedback. The management of networked electronic resources by a library is a way of placing content and context in the hands of a trusted third party or intermediary—the library itself. The context is becoming increasingly important, and evaluation methods like MINES for Libraries are capturing this increasing importance of the library context. The openness of library organizations serves as a catalyst for learning as we implement new evaluation methods in transparent and effective ways.

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