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Project Title: Maximizing Library Investments in Digital Collections Through Better
Data Gathering and Analysis (MaxData)

Maximizing Library Investments in Digital Collections Through Better Data Gathering and Analysis (MaxData) (A Research Project)

Abstract

Libraries make substantial investments in digital collections, especially collections of digital serials. E-journals are preferred by librarians and users because they allow convenient desk-top access and usage log data can be obtained. Libraries need to cost-justify their investments and provide the best resources for their users, so usage data of many types has become essential.

The international COUNTER initiative has set standards for what type of usage log data must be provided by each online vendor, but individual libraries are still faced with making sense of this information and looking at usage patterns beyond a single vendor system. Standard usage log data analysis does not provide in-depth data and usage logs do not answer all questions that help libraries make collection and service decisions. Other types of usage data and analysis, including deep log analysis and data collected on user preferences and behaviors through surveys or questionnaires, provide rich additional information.

Participants in this research project (Carol Tenopir, University of Tennessee, School of Information Sciences; David Nicholas, Ciber (Centre for Information Behaviour and the Evaluation of Research); Gayle Baker, and Eleanor Read, University of Tennessee Libraries; and Donald W. King, University of Pittsburgh, School of Information Sciences) are experts in various methods of usage data collection and analysis for libraries.

Usage log data will be provided by the multi-library consortia OhioLink and by the University of Tennessee. OhioLink leases and loads over 5600 e-journal titles from more than 70 different publishers. All articles are searchable through a single, federated search engine maintained centrally by OhioLink. The University of Tennessee leases access to 254 online systems, providing access to a total of over 12,500 e-journal titles. UT provides linked access through its library catalog, with the library website acting as a gateway to multiple online systems. Unlike OhioLink, UT does not locally load e-journals, but does have a data collection system that collects usage data from UT use of the multiple online systems.

User surveys will be conducted of faculty and students in academic libraries in Ohio and at the University of Tennessee, to correspond to the main user groups represented in the usage log data.

The main goals of MaxData are to help librarians maximize their use of data for decision making, by helping them determine how best to capture, analyze, and use data. These goals will be met by the following objectives and activities: compare usage log data with survey data of the same user groups; compare different levels and techniques of usage log data analysis; compare results from different levels and techniques of survey data capture and analysis; provide models of methods for librarians to capture, analyze, and use data about how e-resources are being used.

Anticipated results include a better understanding of how different methods of usage data supplement or overlap with each other, how usage log data of several depths can assist librarians in making good collection decisions, and what questions are better answered by direct surveys of library users.

Maximizing Library Investments in Digital Collections Through Better Data Gathering and Analysis (MaxData) (A Research Project)

Narrative

Introduction. Libraries are making significant investments in digital collections. In particular, electronic journals and related databases that help users locate journal articles form a large and growing percentage of library collections. Justification of their expenditures and making wise collection development decisions based on usage patterns and user preferences are essential.

This research project (MaxData) proposes to assist librarians in their justifications and decision making by comparing different types of data collection and data analysis. MaxData will compare different types of usage data for the same groups to help librarians learn what kind of conclusions can be drawn from each technique, the limitations and strengths of each, and what types of generalizable conclusions can be drawn if only a single usage data technique must be chosen. A model for the best use of e-journal usage data will be developed.

Usage log data and survey data will be compared for faculty and students in the OhioLink universities and the University of Tennessee. Together, these libraries reach over 600,000 users with over 18,000 e-journals.

National Impact. The move towards electronic collections in libraries is nationwide (indeed, worldwide) and the results of this project will have significant national interest. According to the Association of Research Libraries (ARL), the percent of spending on serials by university libraries increased from under 2.5 million dollars in 1990 to over 4 million dollars by 2000, while spending on monographs held steady or decreased during the same period.¹

Tenopir concluded in a recent report² for the Council on Library and Information Resources that libraries and their users prefer digital collections because: digital journals can be linked from and to indexing and abstracting databases; access can be from the user's home, office, or dormitory whether or not the physical library is open; the library can get usage statistics not possible with print collections; and digital collections save space and are relatively easy to maintain. When total processing and space costs are taken into account, electronic collections may also result in some overall reductions in library costs.³

By the academic year 2000/2001 research libraries spent on average 16.3% of their budgets on electronic resources, compared to only 3.6% in 1992/1993. Some libraries reported spending over 20% of their total budget on electronic resources.

¹ Association of Research Libraries. Monograph and Serial Costs in ARL Libraries. Available at: <http://www.arl.org/newsltr/210/coststbl.html>.

² Tenopir, Carol. 2003. "Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies". Prepared for Council on Library and Information Resources Washington, D.C. August 2003. Available at <http://www.clir.org/pubs/abstract/pub120abst.html>

³ King, Donald W. and Carol Hansen Montgomery. 2002. "Comparing Library and User Related Costs of Print and Electronic Journal Collections: A First Step Towards a Comprehensive Analysis", *D-Lib Magazine*. Available at: <http://www.dlib.org/dlib/october02/montgomery/10montgomery.html>

Between 1992 and 2000 ARL libraries increased spending on electronic resources by 446.9% (with only a 49.4% increase for total library materials.)⁴

The price of serials (either in print or electronic form) has increased steadily, at a pace that far outpaces library budget increases. According to *Library Journal*,⁵ the average yearly subscription price of scientific and technical journals published outside the U.S. (including the majority of commercial STM publishers) rose from just over \$800 per year in 1996 to over \$1300 per year in 2002.

At the same time, the number of peer reviewed journals and the percent of those available in digital form has also increased steadily. According to Ulrich's, in 2003 there were approximately 180,000 active serials being published, over 21,000 of which are peer reviewed journals. Over half of the active peer reviewed journals are available in digital form, with a higher percentage of science, technology, and medicine titles online.⁶ There are actually many more e-serials when those that are not peer-reviewed are included. *Fulltext Sources Online*⁷ lists over 22,147 serial titles that are online from one or more online services. Many journals now provide access to their articles from multiple sources—directly from the publisher and through multiple aggregator services. For example the fulltext of journals such as *Chemical Week*, the *Economist*, *Library Journal* and *Science* are each covered in multiple services like EbscoHost, ProQuest and WilsonWeb.

Adaptability. Librarians in all libraries are faced with the need to justify their expenditures and make decisions about the best form and format for journal purchases. They must collect and interpret data about use of print and electronic journal collections in a way that will help them make good collection development decisions. These decisions should be based on knowledge of user needs, user preferences, and behavior patterns in addition to cost effectiveness of the various online products. Gathering and interpreting reliable data on needs, preferences, and use patterns has become a necessary challenge for all libraries.

MaxData focuses on academic libraries, but techniques and results are adaptable to any library that provides access to digital collections and seeks to better understand user behavior, preferences, and usage of these collections. The resulting recommendations and usage data model will be widely adaptable in all types of libraries. Widespread dissemination through the project website, professional conferences, and the library literature will ensure that libraries get the information about the project they need to adapt it to their own situation.

Design. The proposed MaxData project will compare different methods of usage data for the same user groups to help librarians learn what types of conclusions can be drawn from each technique, the limitations and strengths of each, and what types of

⁴ Association of Research Libraries. Statistics and Supplementary Statistics.

⁵ Van Orsdel, Lee and Kathleen Born. Periodical Price Survey 2000: Pushing Toward More Affordable Access. 2000. *Library Journal*, 125(7), p. 47-52; and Van Orsdel, Lee and Kathleen Born. Periodical Price Survey: Soing the Digital Flip. 2002. *Library Journal*, 127(7), p. 51-56.

⁶ From www.ulrichsweb.com and Tenopir, Carol. "How Many Online Journals Are There?" *Library Journal* February 1, 2004".

⁷ Fulltext Sources Online, January 2004. Information Today, Inc., Medford, N.J.

generalizable conclusions can be drawn if only a single usage data technique must be chosen.

The main goals of the MaxData project are to help librarians maximize their use of data, by helping them determine how best to capture, analyze, and use usage data. These goals will be met by the following objectives and activities:

- compare usage log data with survey data of the same user groups;
- compare different levels and techniques of usage log data analysis;
- compare results from different levels and techniques of survey data capture and analysis;
- provide methods for librarians to capture, analyze, and use data from their users.

Tenopir⁸ emphasizes that the method or methods used in a research study determine what types of conclusions can be drawn about the sampled participants and what findings can be generalized to the population as a whole. Wang⁹ provides an overview of methods for user behavioral research. User studies for libraries generally use one or more of the following methods:

- surveying users
- interviewing users (including focus groups)
- observing users through experiments, natural settings, or log analysis.

Covey¹⁰ also categorizes usage studies to help librarians design the most appropriate studies for the type of information they hope to gather. Covey's categories of research studies are similar to Wang's and include the following:

- surveys (questionnaires)
- focus groups
- user protocols (experiments and observations are both included here)
- other (heuristic evaluations, paper prototypes and scenarios, and card-sorting tests)
- transaction log analysis

Each of these methods has some advantages and disadvantages. According to Covey, problems or concerns with surveys include the following:

- General surveys are time-consuming and expensive to prepare, conduct, and interpret.
- Unless follow-ups are sent so longitudinal analysis can track changing patterns of use, surveys provide no baseline data.
- People receive many surveys, and it is difficult to motivate them to complete and return surveys.
- The usage information gathered in general surveys might better be gathered by transactional logs.
- Specific surveys are more beneficial, but must be repeated over time.

⁸ Tenopir, Carol. 2003. "Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies". Prepared for Council on Library and Information Resources Washington, D.C. August 2003. Available at <http://www.clir.org/pubs/abstract/pub120abst.html>

⁹ Wang, Peiling. c2001. "Methodologies and methods for user behavioral research." *Annual Review of Information Science and Technology*, Vol. 34, 1999, 53-99.

¹⁰ Covey, Denise T. 2002. Usage and Usability Assessment: Library Practices and Concerns. Council on Library and Information Resources Washington, D.C. Available at: <http://www.clir.org/pubs/reports/pub105/contents.html>

- User satisfaction surveys may not provide enough information to solve the problem, and service “gap” surveys are more difficult to administer and analyze.
 - A survey is only as good as the wording of the questions and the response rate.
- Problems with transaction log analysis, according to Covey, include the following:
- Deciding on the right and most useful usage statistics
 - Collecting the right usage statistics
 - Getting the right and consistent usage statistics from vendors
 - Analyzing and interpreting data (it can be time consuming and difficult)
 - Presenting the data in a meaningful way

In summary, the conclusions that can be drawn from studies depends on the methods used, including the overall method(s), types of questions asked, level of questions, and participants studied. It may be tempting for a researcher to draw broader conclusions than his or her methods justify. It can be difficult for librarians to know what type of data will provide them with the type of information they most need for their decision making. Because it is impractical in all but the largest studies of a particular group of users to use more than one or a limited number of techniques, it is difficult to know whether the conclusions drawn from one data collection method are generalizable.

This project will use the following data collection techniques, run by researchers who are experts in these techniques:

- COUNTER-compliant log data analysis,
- deep log analysis that goes beyond minimal COUNTER log data,
- surveys of the same user groups, using preference and “last incident” questions.

Each is described briefly here, with more details in the attachments.

Project COUNTER¹¹ (Counting Online Usage of NeTworked Electronic Resources), an international cooperative initiative of librarians, publishers, and professional organizations, has developed standards for the delivery of usage data about online products to library customers. COUNTER-compliant services include many of the major electronic services and provide libraries with somewhat consistent usage log data. For one type of data—usage log data—COUNTER is helping in the gathering aspect. COUNTER does not solve all of the needs, however, because it provides only fairly superficial usage log data about each system separately and leaves the aggregation across systems and interpretation up to the individual libraries.

A more in-depth log analysis (called “deep log” analysis) is proposed for this project. Deep log analysis is a methodology specifically developed by the Ciber group (Centre for Information Behaviour and the Evaluation of Research)¹² to obtain robust and deep data on information seeking behavior in digital environments. David Nicholas, Director of Ciber, says that logs are an attractive method because they “record use by everyone who happens to engage with the system.”¹³ Logs produce more accurate and specific portraits of information users and their behavior. Ciber has developed a number of metrics that enables monitoring engagement with the service automatically and remotely. In particular deep log analysis helps determine:

¹¹ Project Counter website: <http://www.projectcounter.org/>

¹² Ciber is a unit within the City University in London.
<http://www.soi.city.ac.uk/organisation/is/research/ciber/index.html>

¹³ See Attachment 1 for detailed description of deep log analysis.

- Whether, as a result of widespread and easy digital access to journals, there is now a new (and relatively unknown) audience with, perhaps, different needs (occasional users, bouncers for instance)?
- Whether people are conducting current awareness searches online with the frequency one would have expected.
- How many users are 'loyal' and revisit, and how these users differ in character from those who do not.
- What is the impact of massive digital choice, in the form of Big Deals and the like, on the user's information seeking behavior?
- What content/resources are, or are not, being used? Log analysis provides the ability to correct the latter by measuring and enhancing their 'digital visibility'.

Survey data asks questions and provides answers to some things not available through usage logs. Preferences and perceptions, for example, can help answer questions about why people interact with e-resources in the ways they do and what they will be likely to use. Correlations with demographic information can reveal individual differences in reported behavior and preferences. These standard questioning techniques will be supplemented in this project with the critical incident technique to measure characteristics of readings, rather than just overall measures of use.

A "last reading" variation of the critical incident technique, used for three decades of research by Tenopir and King, asks respondents to focus on the specific article read most recently to uncover details about this reading. Such details include how the reader first learned about the article, where they obtained it, time spent obtaining and reading the article, format of the article when last read, age of the article, and consequences of having read the article.

The power of this variation of the critical incident technique is in the fact that every reading is different. Detailed patterns of information seeking and reading can be determined, such as how older articles are identified or where they are obtained or what proportion of reading from personal subscriptions or from library collections are in electronic format, and so on. Such details about a specific reading are more likely to be recalled accurately by the respondent better than by asking general usage kinds of questions. With the details of information relating to one reading, researchers can explore hundreds of combinations of information-seeking and reading patterns.

Management Plan. Usage log data will be provided by the multi-library consortia OhioLink and by the University of Tennessee. OhioLink leases and loads over 5600 e-journal titles from 70 different publishers. All articles are searchable through a single, federated search engine maintained centrally by OhioLink. The University of Tennessee leases access to 254 online systems, providing access to a total of over 12,500 e-journal titles. UT provides linked access through their library catalog, with the library website acting as a gateway to multiple online systems. Unlike OhioLink, UT does not locally load e-journals, but does have a data collection system that collects usage data from UT uses of the multiple online systems in addition to receiving COUNTER-compliant data from a number of vendors.

UT will conduct user surveys of faculty and students in academic libraries in Ohio and at the University of Tennessee, to correspond to the main user groups represented in the usage log data. UT will donate some of the time required by the project

participants, with the rest allocated to the grant. Donald W. King of the University of Pittsburgh will donate his time as consultant on the survey data collection and analysis and comparative data analysis.

OhioLink has agreed to donate their usage log data and allow us to survey faculty and staff in Ohio academic institutions. City University's Ciber institute, the originators of deep log analysis software and techniques, will load and analyze the OhioLink data as a subcontractor to the project.

UT will provide usage log data. UT librarians will be responsible for describing and analyzing log data provided by COUNTER-compliant vendors and the data UT captures internally. Surveys will be conducted by UT and the final comparison of results from the different methods will be the responsibility of UT.

The following three year management plan will be followed:

Year 1: Project Design and Set-Up. Ciber will receive, load, and encode and process usage log data from OhioLink and make test data analysis runs. UT libraries will select and isolate a portion of their usage logs from vendors and collected internally and encode and set up data for data analysis. UT SIS will develop questionnaires for faculty and students in Ohio and Tennessee and run pilot tests. Samples will be drawn from the user population and questionnaires will be distributed.

Year 2: Intensive Data Analysis. Ciber will analyze OhioLink data using deep log analysis. UT libraries will analyze UT data using standard data analysis techniques. UT SIS will receive returned questionnaires, input and analyze data. Internal reports will be drafted to share with all members of the team.

Year 3: Data Analysis Refinements, Comparison, and Dissemination of Results. Results and data analysis techniques will be compared by all team members. Necessary refinements in data analysis techniques or extensions of analysis will be made. Reports will be prepared and results disseminated widely by all project participants.

Budget. Most of the budget requested for this project will go to pay for the time of the principal participants, including Ciber as a subcontractor and University of Tennessee librarians and School of Information Sciences faculty.

Because Ciber has already developed the software and expertise for deep log analysis and has the computer resources necessary to load and process large volumes of data, we have determined that it is more cost effective to use their expertise and facilities on a subcontracting basis. OhioLink has agreed to provide their usage log data to Ciber for this project.

We also request two one-half time graduate student assistants to help with all aspects of the project, including questionnaire design, data input, and data analysis.

The project will be administered by the Center for Information Studies, a research center of the School of Information Sciences at the University of Tennessee.

Most of the cooperative work over distances will be done over e-mail and by teleconferencing. Travel monies in the amount of \$1,500 each for Tenopir, Baker, and Read are requested in years two and three to meet and present findings at professional conferences. As stipulated in IMLS application guidelines, travel for Tenopir, Baker, and Read to attend the IMLS Outcomes Based Evaluation training and other IMLS-

designated meetings in Washington, DC is requested, at a cost of \$2,000 per year for three years.

Contributions. A portion of the time required for project participants will be donated by each institution each year. Donald W. King (Research Professor, University of Pittsburgh) will donate his time to the project. All necessary hardware and software required for the project will be donated by Ciber and the University of Tennessee.

Personnel.

Carol Tenopir, Professor, University of Tennessee, School of Information Sciences: has worked with all of the project participants in the past and will lead this project. She is a prolific author and award-winning researcher. Critical (or last) incident technique in user studies is the main method used by Carol Tenopir and Donald W. King in studies of thousands of journal users conducted from 1977 to the present. A bibliography of her prior work with Donald W. King in user surveys is included as an attachment. She will devote 25% of her time to this project, 5% of which will be donated, for each of the three years.

Donald W. King, Research Professor, University of Pittsburgh, School of Information Sciences: developed and demonstrated the value of the critical incident technique in readership studies from the 1970s to the present. A renowned researcher and author of many books, reports, and articles on user studies, Professor King and Dr. Tenopir have worked together on user studies for nearly a decade, resulting in dozens of articles and two monographs. (See attached bibliography). Mr. King will donate 20% of his time in an active consulting role for this project for each of the three years.

Gayle Baker, Professor and Electronic Services Librarian, University of Tennessee, Libraries: brings a decade of experience with usage log data collection and interpretation, using data collected in house as well as vendor-provided COUNTER-compliant and non-compliant data. She will devote 20% of her time to this project, half of which will be donated, for each of the three years.

Eleanor Read, Assistant Professor and Data Services Librarian, University of Tennessee Libraries: holds master's degrees in both statistics and library and information science. She has worked with both Tenopir and Baker in usage data analysis for library decision-making. She will devote 20% of her time to this project, half of which will be donated, for each of the three years.

David Nicholas, Professor, Ciber and City University, London: Deep log analysis has been perfected by David Nicholas at Ciber, who will subcontract for this project. Nicholas and Tenopir worked together last year at a Ciber-sponsored workshop. A detailed description of deep log analysis and Ciber's unique role in developing and testing this technique is included as an attachment. Ciber's subcontract will include all costs associated with Professor Nicholas's time and programming staff, for a fixed-fee total of \$50,000 per year for each of the three years.

Project Evaluation. Libraries collect and report a variety of data to measure progress toward objectives and to assess the extent to which the library meets the specific needs of its institution and its user community. Libraries have become increasingly adept at counting inputs and outputs as a measure of their effectiveness. Librarians recognize

that current measurement systems must evolve to meet the challenges brought on by a growing dependency on electronic resources.¹⁴

The MaxData project seeks to determine how to engineer a system that adequately measures the effectiveness of the library's electronic resources. In a sense, this research project is in itself an evaluation—the testing and evaluation of various methods of usage data collection and analysis—so the evaluation will be of the project methods to ensure validity and reliability of results. In the long term, the beneficiaries of the outcomes for this project will be the users of library electronic resources, who will benefit from the best choice of appropriate formats, collections, and user-centered systems. Both long and short-term beneficiaries will be librarians who will be provided with the information they need to collect and analyze the most appropriate and effective usage data for their collections and decision making. Within the time constraints of three years it will be difficult to directly measure the long term outcomes—much of the long-term benefits must be implied from evaluation of the achievement of the specific goals and objectives of this research project.

MaxData will be evaluated in the following ways: 1) log data analysis methods and questionnaire instruments will be pre-tested in year 1 to ensure the questions asked are the right ones and that the proposed measurements are valid. Pre-tests will be conducted by project participants, under the supervision of Donald W. King. Changes and corrections will be made. 2) The University of Tennessee will implement log data analysis in year 2 based on the methods designed and tested in year 1. Results of this implementation will be evaluated and reported. 3) Results from all methods used in year 2 will be compared in year 3. Much of year 3 will be comparing results from the methods, examining discrepancies in detail and accounting for discrepancies. This evaluation will be conducted by all members of the research team and will be reported in project reports. The final results will be validated, reliable, and compared research methods.

Dissemination. Carol Tenopir, lead researcher on MaxData, is an experienced speaker and prolific author of research articles. She has coauthored many articles with project participants Donald W. King, Gayle Baker, and Eleanor Read, and has worked on Cyber research initiatives with David Nicholas. The project participants will disseminate interim and final results of MaxData widely.

Conference presentations of preliminary and final results will be submitted to professional meetings such as the annual meetings of the American Society for Information Science and Technology, Association of College and Research Libraries, Charleston Serials Conference, and North American Serials Interest Group. (Almost all of the project participants have presented research at these meetings in the past.)

Articles will be prepared and submitted for publication in peer-reviewed journals and trade journals that are targeted to academic librarians. These may include: *College & Research Libraries*, *Journal of the American Society for Information Science & Technology*, *Library & Information Science Research*, *Serials*, and *Library Journal*. The participants have all published in one or more of these journals, while Tenopir writes a

¹⁴ Rudd, Peggy E. "Documenting the Difference: Demonstrating the Value of Libraries through Outcome Measurement." In *Perspectives on Outcome Based Evaluation for Libraries and Museums*. Institute of Museum and Library Services. Available at: <http://www.ims.gov/pubs/pdf/pubobe.pdf>

regular column for *Library Journal* and Baker and Tenopir write an annual database marketplace analysis for *Library Journal*.

A project website will be established at the beginning of the project to post interim and progress reports, pre-prints, final articles and reports, and substantive materials such as survey instruments, detailed descriptions of data analysis techniques, etc. The website will be maintained at the University of Tennessee, School of Information Sciences, but all project members will contribute to its content.

Sustainability. The widespread dissemination of project results, including detailed data analysis, comparison of methods, and a model for usage data best practices, will ensure the usefulness of the MaxData research project long past its completion. In addition, we anticipate that the methods developed will continue to be used at the participating institutions. Additional projects using the methods and lessons learned from this project will be pursued by the project participants.

The data gathered from surveys conducted for MaxData will be incorporated into the longitudinal data collection maintained by Carol Tenopir and Donald W. King. This data set, built from 1977 to the present, currently includes responses from nearly 20,000 respondents. The University of Tennessee and Ohio institutional responses will be added to the massive data set, to provide ongoing longitudinal analysis. No one else has such a rich set of journal usage data.

A bibliography of articles and books by Tenopir and King that describe their research projects using the critical incident technique in user reading surveys follows.

Tenopir and King Bibliography

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