

Connecting People with Information by Improving Information Architecture

Haymwantee P. Singh, MSIE, MLS
Technical Reference Librarian
R. V. Van Houten Library
New Jersey Institute of Technology
Newark, NJ

Abstract

Researchers or consumers of library information require access to a huge amount and variety of information sources in order to accomplish their work. However, current information systems are driven primarily by technological feasibility, not end-user needs. It is often technologists who design these systems, with little input from users. This paper addresses the issue of increasing complexity in information architecture and why it is important for libraries to work with vendors on a user-centered design (UCD) process that can better help connect people with information. This paper will outline UCD as it applied to the development of Scopus, an abstract and citation database of research information jointly developed by Elsevier and dozens of research institutions around the world.

Introduction

The proliferation of digital resources over the past decade is beginning to require librarians to face issues that were previously the provenance of software designers and specialists in the field of Human-Computer Interaction (HCI). Stretching back to Johann Gutenberg few, if any, have fretted about the usability of the printed page. Likewise, while some library terminology may be a foreign concept to consumers of library resources, this was less of a problem when users had to physically enter the library to access them. After all, a librarian was always on hand to help.

Digital library resources, however, continue to pose challenges. Are systems usable? Do individual systems integrate well with other library resources? Do they require special training or are they designed to be intuitive and easy to use? Answering these questions require librarians to begin considering topics usually reserved for software architects such as the quality of the user interface and the underlying architecture of the system. In addition increasing costs and decreasing budgets are forcing librarians to focus on ensuring that these resources provide real value. The bottom line: does the investment in digital resources justify the cost when measuring their actual utilization.

It is in this environment that the library community, over the past decade, has begun to consider some of the same questions pondered for years by Web designers and software architects. Several libraries have already conducted in-depth studies gauging the usability of their digital resources (see, eg. Dee & Allen), while others have published case studies outlining the development of resources (see, eg. Augustyniak, et al).

One often overlooked facet, however, is the role of the supplier or vendor in creating usable systems that easily connect people with information. Librarians have traditionally maintained a typical business relationship with their suppliers that is focused primarily on cost. However, by partnering with vendors libraries can ensure mutually beneficial results (Goodyear & Alexander). In particular, by partnering early in the development process libraries can get a better understanding of the system in question and ensure it meets the specific needs of their users (Wiser).

This paper outlines a process for librarians to work with vendors to ensure digital resources are designed from the outset to be usable. This process, user centered-design (UCD), has been a staple of computer science for years and by adopting it libraries can overcome the challenges posed by online information systems. The paper will also provide a case study of how UCD and a vendor-librarian partnership resulted in the successful development of Scopus, an abstract and citation database of research information.

User-Centered Design

The roots of UCD can be found in Jakob Nielsen's *Usability Engineering* which discusses usability engineering from the early design stage through the completion of the system. Broadly speaking, usability engineering, or UCD, is the name given to a set of processes, including focus groups, user interviews and so on, that serve to refine a product from initial concept to finished product based on user testing and feedback (Nielsen).

The goal of UCD is to ensure a system's overall usability: "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO)." In a library setting, this means ensuring that systems are easy enough for the broad spectrum of library users to take advantage of. As it applies to online resources specifically it means that, "for the tasks it is designed to support, an interface must be easy to learn, remember, and use, and must lead to few errors (Battleson, et al)."

UCD as it pertains to online information systems is particularly important because of the wide range of factors that can positively or negatively affect the usability of an online resource. A multitude of factors can affect the usability of a Web page and, in so doing affect the time it takes to perform a task as well as the resulting accuracy. For instance, recent studies have taken into account the affect of graphical display and screen

ratio on usability (Schaik and Ling, September 2006), and the affect of font type and line length on online searches (Schaik and Ling, May 2006).

In addition, the complexity of digital resources means that UCD must consider not only the look and feel of a system – the user interface – but also the underlying system architecture. Rafla, et al, write that: “Even when the presentation and functionality of a system are well designed, its usability could be compromised if the underlying system architecture does not support usability concerns.” They add: “Moreover, it often proves difficult to make the changes to a system that are necessary to improve its usability.”

UCD in the Library

Within the library community usability engineering seems to be more focused, on testing finished systems to gauge their utilization rates and usability. Most of these studies conclude, or at least imply, that by taking a UCD approach from the outset, digital resources would be, at a minimum, better aligned to users’ needs and, at a maximum, achieve higher utilization. As Battleson, et al, reported in their tests of an academic library Web site “the importance of usability testing and the applicability of usability testing to library Web sites cannot be understated.” They continue, “usability test methods serve as both catalysts for design changes and as tools for evaluating those changes.” They conclude:

“When developing a new site . . . Does the site provide task support? Is it usable? . . . These questions are necessary elements of successful and usable Web site design. However these questions must be directed at real users, who are the key to successful usability testing.”

Other reports make similar comments. Cockrell and Jayne write that “Discovering users’ search behaviors and their needs was a transforming experience.” In their survey on the usability of digital services in health science libraries Dee and Allen wrote that usability is the “developmental keystone of a successful online library presence . . . if users cannot access the information easily, there is little point in expending the enormous amount of effort and expense.” While their study showed that their users were not having much success using their system to find articles they did conclude that, “we were empowered and energized by knowing what needed to be addressed.”

The dangers of ignoring user’s needs when developing online systems has also been addressed by the library community, as Gullikson, et al write “a site may be visually appealing, contain all the resources that meet the site’s objectives, but still be humanly unusable.” As Morgan writes the emerging consensus seems to be, “if your services are not user-centered, then your services will not be used.”

Library-Vendor Partnering

As libraries are waking up to the need to incorporate UCD in the design of digital resources, we are experiencing a second, related, awakening: the need to partner with vendors to achieve desirable results. Goodyear and Alexander note that “A library’s ability to acquire, catalog, and circulate material depends on vendors.” They explain that “the ability to deliver quality services depends on our ability to manage effectively our relationships with these suppliers.”

Goodyear and Alexander outline a new model relationship between the library and supplier based on the concept of a ‘business partnership.’ In this new model the focus shifts from arguing about price, to maintaining an ongoing dialogue that ensures that libraries and suppliers are each minimizing their distinct costs and best serving the needs of their distinct customers (Goodyear and Alexander). The goal, they write, “should be a mutually beneficial relationship,” resulting in “significantly improved service deliver to the library user.”

As it pertains specifically to the topic of UCD, partnering with vendors can help ensure library systems are optimized for the specific needs of users. As Cervone writes, “Often, solving usability issues can only be accomplished by partnering with our vendors to design solutions that work better for our patrons.”

Case Study: Scopus

In early 2002 Elsevier began discussions with librarians and researchers from all over the world in order to assemble preliminary input and guidance to help shape what would, on its launch in November 2004, be known as Scopus, an abstract and citation database of research information. In the space of two years Elsevier would work with hundreds of researchers and librarians, including librarians at the New Jersey Institute of Technology (NJIT), to develop and refine the system, thereby ensuring it was well aligned with the needs of end users.

A total of 302 researchers and librarians from 21 institutions on four continents would ultimately participate in the UCD process. Their efforts helped define what Scopus would cover and how Scopus would provide access to information. The result is the largest abstract and citation database of research literature and quality Web sources. Continuously updated based on user feedback, Scopus provides easy access to:

- 15,000 titles from 4,000 publishers
- Over 12,850 academic journals including coverage of 525 Open Access journals
- 750 conference proceedings
- 600 trade publications
- 27 million abstracts
- 245 million references, added to all abstracts
- Results from 250 million scientific Web pages
- 12 million patent records from 4 patent offices
- Seamless links to full-text articles and other library resources

The UCD Process

NJIT's involvement with Scopus began in October 2003 when the institute signed on to join the development partner program. The Scopus project was appealing because it afforded the institute the chance to influence the development of a system that would provide access to information that very closely matched the needs of NJIT's researchers.

The first challenge in designing Scopus was to devise the framework for incorporating user feedback. Because the system was intended to cover multiple scientific disciplines and a massive number of references, a UCD process had to be devised that would take into account the views and needs of a large and disparate group of researchers and librarians.

NJIT, along with Scopus and the other development partners, devised a three-phased UCD approach. The first phase was focused on understanding the unique needs of users, their tasks and the environment in which they worked. Phase two consisted of producing mock-ups of the system, based on the user feedback. The third and final phase consisted of user evaluations of the mock-ups. In particular, the evaluations would focus on user behavior as it related to specific tasks, such as searching. Ultimately Scopus would go through 14 rounds of user testing over a period of two years before it was ready to be launched.

The process began in 2003 with a series of user interviews. Researchers were asked to both show and explain to interviewers how they used and interacted with existing research systems. The purpose of this was ensure that researchers, to whom using a particular system may be second nature, would not forget to include a key step in their search process. As a result the design team came away with a better understanding of researcher's motivations. The team was also able to hypothesize the ideal researcher workflow and incorporate that into early designs.

These designs were taken back to the researchers for successive rounds of testing. Initially these tests consisted of examining mock-ups of screens. As the UCD process advanced these screens were replaced by functioning prototypes. Researchers were monitored using these prototypes to gauge the degree to which they succeeded in easily connecting researchers to the information they sought. The design team tested concepts such as the value of using citation data during research as well as specific pieces of functionality such as basic and advanced search forms.

User test sessions transpired over approximately one hour each. Each session began with interviewers asking researchers basic questions about how they use and interact with information sources. The interviews were followed by the actual testing sessions, during which the concepts and functions were monitored and tested. Results were controlled by varying the order in which different researchers tested functions, thereby ensuring that the mere order of tests did not affect the test results. Researchers were then asked to rate functionalities and provide additional feedback.

Ultimately NJIT and the rest of the development team would go through 14 rounds of user testing over a period of two years before Scopus was ready to be launched. The successive rounds of testing would help the team refine the system architecture and structure Scopus in such a way as to closely match the research workflow. During the process we learned some interesting things about how researchers worked, and what was most needed in an abstract and citation database.

Aligning System Architecture to User Needs

The UCD approach helped NJIT and the rest of the design team identify key elements an abstract and citation database needed to have beyond an easy and intuitive search system. These included the ability to:

- Export selected citations in bibliographic style of choice.
- View the elements of a citation in a tabulated style.
- Sort the results set on the elements of an article such as “cited by”, document relevancy and date.
- Search variations of an author’s name.
- Search within the references of articles.
- Easily search across disciplines, without knowledge of other areas of expertise.
- Easily stay-up-to date on developments in a given field of study.

Among the other interesting findings:

- Researchers preferred a system that included a summary of search results on the results page. This summary includes lists of categories such as source titles, author names, document types, and subject areas in a descending numeric order.
- The importance of a single interface for all types of scientific data. Researchers find multiple interfaces and system a distraction and therefore requested a system that would focus on providing access to peer-reviewed information while also giving them the option of seeing related Web search results.
- Systems had to be well integrated with library resources so that researchers could move easily from finding a relevant abstract to accessing the full-text article.

UCD’s Impact on NJIT

NJIT’s participation in the UCD process gave us some very valuable insight into our own library operations. First, the overwhelming feedback from our researchers was that the UCD process was a tremendously rewarding experience. Researchers loved having the opportunity to shape the development of a system that would connect them with critical research information.

Second, throughout the process the library staff learned that we needed to add greater value to our user’s education. We found that it was no longer enough for the NJIT library to merely make resources available, we had to make sure resources were usable. In addition, we learned that by taking a UCD approach to developing a core research system we could promote the usage of other library systems, such as our online

full-text resources. By creating in Scopus an easy-to-use ‘front-door’ we could better connect our researches to a wealth of other information.

Finally, from an administration perspective, we learned that it was possible to develop a product that met the needs of researchers over time without adding cost. The UCD approach didn’t stop with the initial launch of Scopus. On the contrary, we found that when libraries and vendors partner, UCD can be a lifelong process in which both organizations work together to consistently improve and enhance the system.

A Lifelong Commitment to UCD

Since the launch of Scopus in 2004, NJIT and the other development partners have continued the UCD process. New enhancements and features are tested in the same way, ensuring that Scopus remains closely tuned to the needs of researchers. While much of the post-launch UCD has been focused on smaller enhancements to navigation or searching, the ongoing relationship between Elsevier and its users has yielded some significant new features, most recently the Scopus Citation Tracker.

The Scopus Citation Tracker, launched and available to all subscribers in early 2006, enables users to evaluate research by leveraging citation data. Researchers can more easily track citation data, thereby gaining more information about articles, authors, their own published work and research trends.

Tested over several months following the UCD guidelines laid out early in this paper, the Scopus Citation Tracker gives researchers a single view showing them the influence of a group of articles, an author or even a group of authors over time. The Scopus Citation Tracker is designed to allow users to set their own search parameters and come to their own conclusions.

The UCD process and the partnership between NJIT, Elsevier and the other development partners continue to go strong. In the coming months and years we will continue to work together to design new features and ensure that Scopus is closely aligned to the needs of its users.

Conclusion

Librarians recognize that digital resources bring with them unique problems that require novel solutions. It is not enough for a library to simply acquire an online catalogue of research information or license a system for conducting online research. On the contrary, librarians must be actively focused on ensuring the usability of online resources. As Malhotra and Galleta write, “Even the best designed information systems are not used if they are not aligned with the system users’ motivation and commitment.”

This paper described the complexities associated with online resources and how librarians are beginning to use the tools of usability engineering to analyze the usability

of their resources. It outlined, using a case study approach, how UCD and library-vendor partnering helps librarians better serve the consumers of library resources.

BIBLIOGRAPHY

- Augustyniak, Rebecca, A. Finley, D. Aguero, B. Monroe, and B. Arsenault. "The Information Professional's Role in Creating Business Management Systems." SLA 2005 Annual Conference, Toronto, Ontario, Canada.
- Battleson, Brenda, A. Booth, and J. Weintrop. "Usability Testing of an Academic Library Web site: a Case Study." *The Journal of Academic Librarianship* 27, no. 3 (May 2001): 188-198.
- Cervone, Frank. "What We've Learned from doing Usability Testing on OpenURL Resolvers and Federated Search Engines; Frequently Asked Questions in Library Websites; Usability Testing for Library's Main Site." *Computers in Libraries* 25, no. 9 (October 1st 2005): 10.
- Cockrell, Barbara, and E. Jayne. "How do I find an Article? Insights from a Web Usability Study." *The Journal of Academic Librarianship* 28, No. 3 (May – June 2002): 122-132.
- Dee, Cheryl and M. Allen. "A Survey of the Usability of Digital Reference Services on Academic Health Science Library Web Sites." *The Journal of Academic Librarianship* 32, no. 1 (January 2006): 69-78.
- Goodyear, Marilu and A. Alexander. "Libraries as Customers: Achieving Continuous Improvement through Strategic Business Partnerships." *Library Acquisitions: Practice and Theory* 22, no. 1 (5-14).
- Gullikson, S. R. Blades and M. Bragdon. "The Impact of Information Architecture on Academic Web Site Usability." *Electronic Library* 17 (1999) 293-304.
- ISO DIS 9241-11, *Ergonomic Requirements for Office Work with Visual Display Terminals. Part 11: Guidance on Usability* (London: International Standards Organization, 1994), p. 10.
- Malhotra, Yogesh and D. F. Galletta. "Building Systems That Users Want to Use." *Communications of the ACM* 47, no. 12 (December 2004): 89-94.
- Morgan, Eric Lease. "Portals in Libraries: Portal Implementation Issues and Challenges." *Bulletin of the American Society for Information Science & Technology* 31 no. 1 (October 1st 2004): 22.
- Nielsen, Jakob. *Usability Engineering* (Boston: Academic Press, 1993).

- Rafla, Tamer, P. Robillard and M. Desmarais. "Investigating the Impact of Usability on Software Architecture through Scenarios: A Case Study on Web Systems." *Journal of Systems and Software* 79, no. 3 (March 2006): 415-426.
- Schaik, Paul van and J. Ling. "The Effects of Graphical Display and Screen Ratio on Information Retrieval in Web Pages." *Computers in Human Behavior*, 22, no. 5 (September 2006).
- Schaik, Paul van and J. Ling. "The Influence of Font Type and Line Length on Visual Search and Information Retrieval in Web Pages." *International Journal of Human-Computer Studies* 64, no. 5 (May 2006): 395-404.
- Wiser, James. "Kaizen Meets Dewey: Applying the Principles of the *Toyota Way* in Your Library." SLA 2005 Annual Conference, Toronto, Ontario, Canada.