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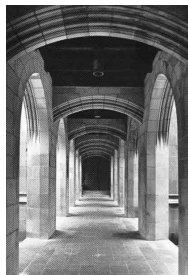
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THE INTERNET HAS CHANGED, LIKE, EVERYTHING

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“The popularity of the Internet is the most important single development in the world of computing since the IBM PC was introduced in 1981.”

—Bill Gates, *“The Road Ahead”*

This assessment by the Microsoft chairman in 1995 has been reaffirmed many times and by many experts over the last decade. In his best selling book *The World is Flat*, author Thomas Friedman identifies ten “flatteners” that are driving global economic shifts and changing the lives and work of billions of people; the emergence of the global Internet is central to almost all of them. The impact of the Internet on libraries has been no less dramatic, changing not only our daily activities, services, and professional preparation but the very notion of the library itself. No single area of modern librarianship has remained unaffected by the Internet and the related technologies that have grown up within and around it. So on one level, it is fair to say that *the Internet has changed everything*.

How dramatically one sees these changes depends in large measure on whether one is of the “BW” (“Before Web”) or “AW” (“After Web”) generation. Those who came of age in the Web-less world tend to be much more amazed by the changes it has wrought, while those who grew up post-Web seem to take it for granted as much as electricity or running water. This is to be expected: past generations are usually unimpressed with the technological marvels that preceded them. The fact that one can pick up a telephone and have voice communication with almost anyone in the world probably seemed much more magical to those who grew up in a time of telegrams than to those growing up in today’s world of ubiquitous mobile phones. But even though we live in an ever flattening world where nearly universal Internet access, wireless networks, mobile phones, and 40 GB iPods can be taken for granted, it is still informative to step back

and examine how the Internet has changed so much for so many so quickly.

THE INTERNET, LIBRARIES, AND USERS

Libraries have recast nearly every service in a way that utilizes the Internet or reacts to it in some way. The stand-alone computers, CD-ROM databases, and “dumb terminal” online public-access catalogs that were once the showcase of information technology in libraries have given way to wireless Internet-connected computers and Web-based catalogs that are being enhanced with personalization features and richer record display ala Amazon. Where libraries once debated whether or not they should get on the “Internet bandwagon,” it is now nearly universally available and fully integrated within the library. Surveys for the U.S. National Commission on Libraries and Information Science document this dramatic shift (Bertot and McClure). In 1994, of the nearly 16,000 public libraries in the United States, only one in ten provided Internet access; now nearly all do.

The huge increase in infrastructure and Internet Service Providers that took place during the technology boom of the 1990s has also greatly enhanced rural Internet access for libraries and individuals, as evidenced by the fact that of the 53% percent of public libraries in rural areas, 93% were connected to the Internet by the end of that decade. Public libraries have now been placed on the front lines of the digital divide debate. Whether one argues that the gap between digital haves and have-nots is closing or not, the role of libraries as a point of access for those who have no other recourse is unquestionably significant. In that same NCLIS survey, most Americans said they know of a place in their community where the Internet is publicly available and public libraries were most frequently identified as that place.

Academic libraries have been equally challenged by shifting user expectations and changing information seeking behavior of the “AW” generation. The Pew Internet and American Life Project reports that 86% of the 16 -18 year old group had gone online (compared to 56% of the general population) and that 79% said the Internet had a positive impact on their education. In addition, 73% of this “AW” group said they used the Internet more than the library, with only 9% saying the library was used more for their information seeking. The Internet is not only integrated into the business of libraries, but more importantly, into the minds of our users.

THE INTERNET AND IT

The Internet has driven huge changes in how we view and use computing and information technology in general, as well as the knowledge base needed to effectively create new information services and instruct others in their use. In the last 20 years there have been dramatic changes in computer and storage technologies, bandwidth capacity and availability, and the acceptance of the Internet. The first of these core changes is how we have come to view the computer itself.

Computer Technology

One can make the case that the Internet was largely responsible for the major paradigm shift regarding computer technology that has occurred during the brief life span of the personal computer; namely, how computing has gone from “crunching to communicating.” When computers were first developed, and through much of their history, they were viewed primarily as computational devices able to do large-scale complex number crunching to support business and science. In the early days of the personal computer, this was still the predominant way computers were viewed, and the first PCs were marketed to small businesses and to individual early adopters. These users needed to be quite enthusiastic about the technology, as computers were relatively expensive at that time.

Of course, over the last several decades the cost of computing has declined and power has increased according to the expectations of Moore’s Law¹, which has been extrapolated to most everything in computing. For instance, in 1971 the Intel 4004 had approximately 2300 transistors and was capable of about 60,000 instructions per second. By 2005, Intel P4 Itanium processors have 410 million transistors and can perform about 10,800 MIPS (about 10.8 billion instructions per second).

And when one considers costs, the changes have also been dramatic. The first hard drive for the original PC was a 10 MB drive that added about \$1000 to the price. Today, there are 60 GB iPods no larger than a deck of cards selling for about \$400 (about 6000x the capacity for less than half the cost). This device can carry about 15,000 songs, but could also represent a personal library of about 50,000 books the size of the ebook version of *The Da Vinci Code*.

Bandwidth

Another essential component of how the Internet has changed the world is the availability and evolution of a connection infrastructure with sufficient bandwidth to support it. Like computer technology itself, this has become a self-reinforcing cycle, as more demand results in more supply and lower costs. The Internet was made possible by an existing telephone network infrastructure that was available throughout the developed world. Up until just 1991, the original NSFNet backbone service used leased T1 lines that could only carry 1.5 Mbps (millions of bits per second). So in that “BW” Internet, the main backbone service of the entire Internet had less bandwidth than many home DSL or cable Internet connections have today.

The “AW” Internet isn’t just for e-mail anymore, as high capacity bandwidth enables voice over IP (VoIP), audio streaming, and real-time video conferencing. There continue to be huge advances in these connection technologies; for instance, fiber optic technologies are being developed that can carry 1 terabit per second on a single fiber strand, which is hundreds of thousands of times the capacity of those original T1 lines. Wireless networking is also contributing to the increase in bandwidth and eliminating many of the barriers associated with a wired environment. Wireless connections and powerful portable computing devices are making Internet access possible without tethering network connections, giving rise to a seamless Internet experience that can be more fully integrated into daily life.

Acceptance of the Internet

Even as computing power was increasing and prices were declining, PC sales did not really take off until the emergence of the Web in the early 1990s. According to the U.S. Census, the number of homes with computers grew from 15% in 1990 to 56% by 2001. Census data also shows that homes with Internet access in the U.S. went from 18% in

1997 to 54.3% in 2003. While other factors such as lower prices and better operating systems certainly contributed to the rapid growth in the PC market during that decade, it seems clear that a major factor was the realization that computers could now connect you to information, people, and useful services. The comparison of the Internet with previous mass communication technologies is also compelling evidence of its success. For instance, it took radio 38 years to reach 50 million listeners and 13 years for television to reach that audience level. The Web reached that many in North America in about 5 years.

Another measure of acceptance is the success of Web commerce. According to the U.S. Department of Commerce, U.S. shoppers spent more than \$50 billion shopping online in 2003, which was an increase of 26.3% from the previous year. This rapid acceptance and broad assimilation of the Internet is especially striking considering that there is a steeper learning curve associated with setting up a computer and connecting to the Internet compared to using previous communication technologies.

THE INTERNET AND THE INFORMATION ENVIRONMENT

The Internet has also brought in new and powerful players in the world of information delivery. Google is one of the best known; their stated mission of organizing the world's information and making it universally accessible and useful sounds rather familiar to those in libraries. Google has launched a number of initiatives such as Google Print and Google Scholar that will continue to shape the information landscape and the role of libraries. As Google, Yahoo, and other companies do more large-scale digitization projects and move into new products and services, the public seems to see less distinction between search engines and libraries. In "The Google Opportunity," Stephen Abram sees much of this as healthy competition that will not only drive libraries in new directions but also make familiar roles even more important, such as in the area of information literacy (Abram 34). Jerilyn Veldof, director of the University of Minnesota Libraries undergraduate initiatives, also sees this as an opportunity, observing that "...libraries are building a bridge between the Google paradigm these students are used to and a much more sophisticated research-library approach to information" (Coventry 2).

Although Google is generally perceived to be a relatively benign corporation with lofty

ideals, the perception that it can, or should, replace libraries raises a number of important issues in addition to convincing users that a Google search is not the same as research. Many wonder if it is really appropriate for one company to take on organizing the entire world's information. In "A Risky Gamble with Google" Siva Vaidhyathan asks: "Should we entrust our heritage and collective knowledge to a business that has been around for less time than Brad Pitt and Jennifer Aniston were together? ...Isn't this the job of universities, libraries, academics, and librarians?" (Vaidhyathan B8).

Related to these broader concerns are the issues of long-term preservation and future archival access to digital resources controlled by a private company whose commitment to such access may change over time. The controversies regarding Google and Yahoo yielding to censorship demands by foreign governments or providing information about users and searches highlight the fundamental differences between a private company, which is accountable to shareholders, and the library, which functions for the public good. While the Internet will continue to spin out companies like Google that will be a source of innovation and partnership opportunities, one of the essential and ongoing roles of the library will be to ensure that issues such as information literacy, access, and privacy are addressed.

Equally important to the direct competition that Internet search engines present is how they have changed the equation in terms of user expectations about ease of use and the interface to retrieval systems. The "Googolization" of searching has given rise to a user community who is less patient with the more complex options that libraries offer, and who prefer the simple "one box" search interface. The cliché that "only librarians like to 'search,' everyone else just wants to find" has more than a kernel of truth for many. In response, libraries are considering innovative technologies and new standards to facilitate metasearch capabilities that integrate information retrieval across the large number of separate, heterogenous databases they manage. Of course, these developments have also fueled the ongoing debate about whether this trend is just a simplification of the interface to make it more "user friendly" or represents a "dumbing down" of the retrieval system that makes it less effective for the power searcher. Once again, we find the trade-offs are not simple and that multiple needs may have to be considered in the options we implement.

THE "LONG TAIL"

Network and digital technologies are converging to create an environment of powerful, compact multifunctional computing devices that can communicate over the Internet independent of time and place. Digital resources also remove the physical constraints that are part of the economic models of the past, as described by Anderson in "The Long Tail," which refers to how a graph of demand for consumer items (books, music, videos, etc) shows a large peak for the popular and a gradually declining level of demand for the less popular. In the physical world, this plot would go to zero hits, as the item would no longer be available; with limited space it is logical to weed the less popular items and fill the shelves with the popular ones. But in the Internet-based digital world, everything can be available, and its global reach increases the likelihood that a sustainable niche market exists for it. This phenomenon is being observed in many digital businesses. Each month millions of people order more than a million movies from Netflix and millions of songs from iTunes, and many of their selections would not be easily available in the retail environment.

That these online activities are not happening in a vacuum can be seen from the corresponding decline of other media outlets. For instance, television network market share has fallen 33% over 20 years and CD sales are down 21% from their peak in 1999 (Nielson Media Research in Storey 6). Newspapers have also declined while Internet use has gained; in the decade since 1994, overall newspaper circulation has fallen by 7.9% (Sloan A16). These trends all certainly apply to the operational assumptions of libraries as we provide access to more and more digital full-text materials. In "The Long Tail and Libraries," Tom Storey of OCLC asserts that two key areas will become increasingly important to the future of libraries: "*Make everything available*" and "*Help me find it*" (8,9). In large measure, "making things available" means "make it digital and available via the Internet" and "help me find it" includes designing new views of library resources such as Amazon-like features that go beyond standard access points and record display.

THE INTERNET AND THE DIGITAL LIBRARIAN

The rapid advance of Internet and computer technologies has also changed what information professionals need to know, even those who are not directly involved in technology

implementation. In a 2002 *Library Journal* Info Tech column, Roy Tennant discusses the "Digital Librarian Shortage" and observes that "...all librarians need not know how to code software. But they should know what software is capable of doing, when a program could be easily written to accomplish a task, and what skills someone needs to write one," and be able to distinguish among the choices one has for such a program. He adds his view that "this kind of knowledge is crucial to good public service" (32).

Whether one wholly agrees with this point of view or not, it is apparent that the level of computing and network knowledge needed to successfully navigate in this new arena of Web-based services has "crept up" over time. For instance, in that "BW" world, computer literacy might simply have meant knowing how to effectively use computers for basic productivity applications such as word processing and spreadsheets, or how to navigate a LAN to access shared documents. But in the "AW" world, the idea of what constitutes basic computer literacy could easily be expanded to include knowing how to determine the IP address of a host computer, assessing the threat of an exposed TCP/IP port or an unknown e-mail attachment, troubleshooting a Web form and the script it posts to, or using scanning programs like OCR (optical character recognition) to digitize content for the Web. Clearly the bar continues to be raised in terms of what constitutes an appropriate technology foundation for those entering, or already in, the library and information profession. It also seems inevitable that the knowledge needed to work in this environment will continue to expand over time and that, in large measure, we have the Internet to thank (or curse) for this new reality.

THE SLIPPERY SLOPE

From the time we took that first step onto the Internet, it has felt to many like stepping onto a slippery slope from which there is no turning back. Keeping up with the accelerating pace of change is confounded by the realization that an awareness of one technology inevitably leads to a need to know another. For instance: the first wave of interest in the Web created the need for us to begin producing Web content, which led us to embrace and learn HTML. But as we learned HTML, we discovered that presentation is problematic in that language, which led us to learn about CSS (Cascading Style Sheets). We then found that static HTML pages do not allow for some desired interactive and dynamic fea-

tures, or allow us to have database-driven content, which leads us to Web programming and scripting. And as we “zoom in” further with any of these topics, we find new layers of detail to master; for instance, Web scripting gives us a number of approaches to consider, such as ASP, PHP, and JavaScript, each with its own advantages and requirements. Just as we may be getting comfortable with this world of Web content in HTML and the accompanying style and scripting technologies, we find that HTML is really not very good for data structuring. This leads us to XML, the extensible markup language, and the possibility of the semantic Web. Again, we “zoom in” and find that XML is really a family of technologies that includes linking technologies (XLINK), a style language (XSL) and style transformations (XSLT). These turn out to be important topics even for non-experts, as XML is influencing other work and standards in many areas. For instance, static HTML pages are being re-worked to comply with XHTML (a re-formulation of HTML that is compliant with the rules of XML). XML is also being used to implement new standards for metadata interoperability, such as the Resource Description Framework, or for new XML-based languages designed to meet specific needs such as the Encoded Archival Description Language (EAD).

The Internet also has opened up many avenues for collaboration and professional development. E-mail was the initial “killer app” of the Internet, and librarians immediately embraced it as a communication and professional development tool. This required us to learn about appropriate netiquette, how to manage electronic discussion list subscriptions, or how to become a list owner. The collaboration possibilities of the Internet continue to expand, leading us to new XML-based technologies such as RSS (Really Simple Syndication) that support blogs and podcasts, both important tools we can use for new services and professional development. Wikis (from the Hawaiian for “quick”), which allow anyone to add or edit Web content, give us new reference tools such as wikipedia.com as well as new ways to collaboratively build and share content (Fichter 30).

And so it goes: every new technology mastered leads us to the realization that there is something else to know or something else coming, and like the Mickey Mouse Sorcerer’s Apprentice, with every broom we slay, dozens of new ones seem to arise in its place. There is no end in sight to this ever-expanding cycle,

and while the profession has always demanded a commitment to lifelong learning, the Internet has both raised the bar and accelerated its pace.

CONCLUSIONS

The Internet and the related Web technologies have changed the world of libraries, providing both new opportunities and new challenges. Looking ahead, it seems inevitable that the pace of change will continue to accelerate and that the Internet will continue to drive much of this change. Topics that will be part of that future include XML applications, open-source software opportunities, and collaborative tools such as blogs and wikis, to name just a few.

This article began with premise that the Internet has *changed everything*, but like most sweeping generalizations, a few qualifying points should be made. First, while the pre-Web Internet certainly had the *potential* to change everything, it is really the “After Web” Internet that has driven much of this change. Internet advocates in pre-Web times sometimes used the *Field of Dreams* reference “If you build it, they will come” to describe how they anticipated the Internet taking hold and changing the world. But much of the anticipated change didn’t really take off until the emergence of the Web, so it seems that it is really more “If you build it, *make it really easy to use and important to people’s lives*, they will come.” That said, it is the Internet that gave us the Web, and Internet technologies continue to be at the center of the digital convergence that has emerged from the mix of cheap and powerful computers, nearly limitless bandwidth, and useful net applications. This convergence is giving rise to what some refer to as the next generation Web or “Web 2.0.” Whatever one calls it, it certainly seems to have reached a sufficient critical mass to remain a powerful engine of change.

Second, while emphasizing the positive impact of the opportunities the Internet has created, there is a dark side to it as well. Pornography and filtering requirements have created many administrative and ethical issues. Privacy and security issues occupy much of our daily attention, and spam is estimated to comprise as much as 80% of all e-mail (Zeller). Misconceptions about the value and usefulness of Internet resources; inappropriate materials; the long-term preservation of digital resources; concerns regarding plagiarism; the cavalier attitude of some regarding copyright; and publisher strategies for digital

rights management that may limit fair use are all just a few of the new issues and complications that are part of the Internet story.

Finally, the notion that it is the Internet, in and of itself, that has changed everything is admittedly a somewhat technological-determinist worldview that does not acknowledge

the full complexity of the broader social and information environment. So while hedging a bit by acknowledging that this premise may not be completely true, it certainly (as Stephen Colbert might say), feels true.

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