*Catherine C. Marshall, Gene Golovchinsky,
and Morgan N. Price*

DIGITAL LIBRARIES AND MOBILITY

Digital libraries offer the promise of anywhere, anytime access to vast online holdings. But what does this promise really mean? If we draw on studies of digital libraries in use, coupled with our development experience with the XLibris analytic reading software [9] on mobile pen-tablet hardware (shown in the accompanying figure), four potential advantages of mobile access to digital resources come to light. Digital library patrons can:

- Perform on-the-spot research to cross boundaries between physical and digital resources;
- Engage in opportunistic reading and annotation, reading when and where other resources are available;
- Use digital content in concert with access to human mediators, such as librarians, analysts, publishers, and colleagues; and
- Interweave mobile information access with other activities such as writing or organizing materials.

People may use mobile digital library technologies to cross physical and digital boundaries. For example, many attorneys and law students use print treatises—in essence, legal encyclopedias—to initiate legal research; the familiar geography of the book helps them get started. They then transition to legal digital libraries (such as those offered by Lexis or Westlaw) to continue their research and to ensure they have checked the most current cases [5].

Patrons also start from digital metadata like Online Public Access Catalogs (OPACs) to access physical holdings. Library patrons can quickly search for new references in a mobile digital catalog while they are browsing the physical shelves [2]. Hence, wireless on-the-spot access can be a compelling advantage of mobile technologies.

Reading is opportunistic; people read when they have time, where they have a comfortable place to sit, and where there are other necessary resources at hand. Furthermore, reading is rarely a one-time linear traversal of a document. We have seen law students mark up a case, then return to their marks to sort out the ones particularly important for the task at hand. These marks may play a continuing role as others read and interpret the same copy of the document.

This view of reading suggests technologies like e-books and mobile reading devices, especially those supporting specific activities that bring value to the reader, show great promise of supporting realistic use of digital library materials.

Access to digital content occurs in concert with access to human mediators and collaborators [4, 6]. This facilitated access may be supported by institutional mechanisms, for example, reference interviews. It may also occur in less formal ways, through colleagues or friends. We have seen analysts help each other find supporting materials given an area of specialization or knowledge of how to use a particular digital library resource [3].

Mobile access to digital libraries enables patrons who work in the field (for example, journalists) to communicate with reference librarians, experts (like analysts or service representatives), or colleagues and peers to facilitate access to holdings [1]. Weaving together content and communication can support the vision of ubiquitous access to digital library materials that also respects estab-

lished collaborative practices and takes advantage of appropriate physical and digital resources.

We often tend to think of information access and reading as activities unto themselves. In practice, analytic reading (the kind of reading most often coupled with information access) leads to other activities: A law student may gather cases and law review articles to prepare for a moot court oral argument; an analyst may search for new cable traffic on a hot topic so she can write a short article about the topic. In short, we must not lose sight of the work context that has motivated the digital library access.

Implications for Design

These observations lead us to a set of technological implications for the design of e-books and other devices for mobile access to digital libraries. These implications include standardized document representations, and appropriate software functionality and hardware form factor.

While PDF affords detailed control over document appearance, it is not well suited to the smaller screen sizes typical of e-books. Markup-based schemes such as WML address this problem by allowing a server to split a document into chunks, but this kind of markup tends to sacrifice appearance. The Open eBook Forum (OEBF) Publication Structure format may be a viable alternative. This format, based on existing standards (XML, CSS, Unicode, among others) provides a mechanism to express document structure and appearance recognizing differences in capabilities among the various devices used to display documents.

The true value of the computer, however, lies in the kinds of operations not possible on paper. Some examples relevant in the digital library context include the ability to support rich forms of searching and link following from within documents; to annotate documents in a fluid manner and to manage those annotations; to share documents—or perhaps annotated portions of documents—as a means of collaborating with peers and experts.

A further design challenge derives from the need for mobility: nobody wants to carry a handheld electronic catalog, a pen tablet for reading and annotation, a laptop for writing or taking notes, a cell phone for communicating with others, a two-way pager for locating information snippets, and so on.

So, what is the Swiss Army knife for the mobile worker in the digital or physical library? Clearly, such a device must support reading comfortably. It should

XLibris software on a Fujitsu Stylistic 3400 tablet computer.

also provide access to external resources such as catalogs and document repositories. It should support writing both quick, informal notes, and creating more elaborate documents. It should be lightweight and easy to hold, yet large enough to display a reasonable amount of text on each screenful.

Does such a device exist today? Not exactly. Yet elements of the ideal can be recognized in some existing computers. The laptop is convenient for entering text, but the horizontal display and fixed position make it awkward for reading. The pen tablet (see figure) is better for reading, but more work is required to design an appropriate keyboard. Smaller handheld computers offer ready mobility, but they may prove frustrating for displaying the range of digital library materials. Connectivity remains a thorny issue for mobile devices in physical libraries. Without appropriate infrastructure, the buildings themselves can render cell phones and wireless networks useless. Thus, the burden of design rests not only on device engineers, but on the designers of physical libraries. **C**

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CATHERINE C. MARSHALL (cathymar@microsoft.com) is Architect at Microsoft Corporation, Redmond, WA.
GENE GOLOVCHINSKY (gene@pal.xerox.com) is Senior Research Scientist at FX Palo Alto Laboratory, Palo Alto, CA.
MORGAN N. PRICE (MorganNPrice@yahoo.com) is Director of Product Design at Public Mind, Scotts Valley, CA.