The Downside of Scholarly Electronic Publishing: Problems in Accessing Electronic Journals through Online Directories and Catalogs

Charlotte E. Ford and Stephen P. Harter

This article reports the results of a study on the usefulness of four online e-journal directories and two online union catalogs in accessing electronic journals. The coverage, accuracy, currency, and overlap among the six sources are compared. Multiple uniform resource locators (URLs) were found for most of the e-journals. Directories were found to include fewer URLs per title than the union catalogs, with a higher percentage of current, functioning URLs; the catalogs offered the highest number of working, current URLs. The findings point to different functions served by directories and catalogs, and highlight the difficulties involved in maintaining these reference sources in the Internet environment. Strategies for improving the accuracy and currency of the catalogs and directories are suggested.

Directories of publications, such as *Books in Print, Ulrich's Periodicals Directory*, or EBSCO's *Serials Directory*, have long been considered standard reference works. Union catalogs, such as OCLC's WorldCat and RLIN, also have provided valuable services to researchers for many years, offering centralized access to millions of standardized bibliographic records for books, periodicals, and other materials located in numerous different libraries.[1] The need for directories and catalogs does not appear to have faded as publications have become available on the Internet; if anything, the need appears to have become more acute. Online "resource guides" abound alongside the Internet search engines, and printed directories to Internet sources (such as *Internet Yellow Pages* and the *Complete Internet Directory*) have been best-sellers in recent years.[2]

However, the Internet presents significant challenges for those who seek to organize even small portions of its content in useful ways. Catalogers attempting to create records for Internet-based publications are faced with questions concerning which resources to catalog, how to create and display the bibliographic records, and how to maintain records for items whose uniform resource locators (URLs) and content may change rapidly and radically.[3] Those attempting to build

Charlotte E. Ford is a Doctoral Student at the Indiana University School of Library & Information Science; e-mail: ceford@indiana.edu. Stephen P. Harter is a Professor at the Indiana University School of Library & Information Science; e-mail: harter@indiana.edu.

and maintain directories encounter similar problems in identifying appropriate resources and maintaining URLs.[4] This article documents and discusses some of the strengths and weaknesses of online directories and cataloging records constructed to provide access to Internet resources, focusing on a particular type of Internet resource of interest to many libraries and researchers: scholarly electronic journals.

Motivation for the Present Article

In the initial stages of a 1996 citation study on the impact of thirty-nine refereed e-journals on scholarly communication, Stephen P. Harter and Hak Joon Kim encountered many access problems and issues related to e-journals.[5] They reported multiple modes of access and data formats, numerous difficulties in connecting to e-journals, incomplete archives, and inaccessible articles. A particularly troubling finding was the inaccuracy of information presented in two printed e-journal directories used by the authors, due mainly to incorrect directory information. Harter and Kim believed that maintaining the directories online and "in a state of continuous revision" might offer a partial remedy to these problems.[6]

This article examines four online directories and two online union catalogs in terms of their coverage, accuracy, currency, and agreement of entries for e-journals. The findings reported here are the result of the first stage of a follow-up study to Harter's 1996 investigation. The aim of the larger study is to assess the impact of e-journals on scholarship and research by studying the hypertext links made on the World Wide Web to the same thirty-nine e-journals previously studied, using the "link:" feature available in Alta Vista, HotBot, and other search engines. The first step in this project was to identify URLs for the home pages of the thirty-nine e-journals so that searches for links to the journal home pages and articles could be conducted. However, it quickly became clear that most e-journals have more than one home page. For some e-journals, there are multiple (mirror) sites for the e-journal (and its home page). In addition, there sometimes are multiple formats (http, gopher, ftp) at the same site as well as multiple versions of the home page URL (several identical pages with different file names for the page, such as home.html, homepage.html, index.html). In three of the first ten e-journals examined, the authors' independent Web searches revealed completely different URLs, each of which could reasonably be considered the "true" home page of the e-journal in question. Furthermore, there were several cases in which each author had discovered significant URLs the other had missed.

The question of what to consider an authentic home page for an e-journal (and concern over how many URLs per e-journal could reasonably be checked for links) prompted a search for an authoritative directory that might provide URLs for e-journal home pages. The first directory checked was the 1996 Directory of Electronic Journals and Newsletters compiled by the ARL and available on the Internet at http://arl.cni.org/scomm/edir/, which was used by Harter and Kim in their study.[7] However, this raised new questions. Each of the first ten e-journals appeared in the ARL directory, which listed one URL apiece for eight titles and two URLs apiece for the remaining two. Of these twelve URLs, one (which functioned and led to current issues) was previously unknown to the authors; one was a URL previously known, but the authors also had discovered an alternative URL for the same title to which many more Web pages appeared to be linked; two were relatively old (more recent URLs had been found); and three did not work at all. Only five of the URLs matched those the authors believed to be the e-journal home page URLs; of the seven that did not match, only one was a relevant, new URL.

With the usefulness of the ARL directory in question, the authors consulted two additional listings: the Committee on Institutional Cooperation's (CIC) Electronic Journals Collection Index and the University of Houston listing of Scholarly Journals Distributed via the World-Wide Web. The CIC directory reflects an effort to establish central coordination or management of scholarly electronic materials; the CIC attempts to maintain timely links and records to e-journals and is building an archive of electronic serials.[8] The University of Houston directory is maintained by the University of Houston Libraries. The variation in coverage, currency, and accuracy in the three directories was striking. Each directory consulted simultaneously yielded valuable new URLs in addition to dated or missing ones. And some e-journals had no entries at all.

When the directories and visits failed to yield any functioning sites (as they did in three cases), Web searches were undertaken using Internet search engines to try to locate a home page.

To establish a basis for conducting "link:" searches, the authors decided to consult several directories for the thirty-nine e-journal titles and record all the http, gopher, and ftp URLs. E-mail and listserv URLs were omitted because they could not be linked to (keeping in mind the overall goal of the larger project). A colleague suggested that searches on OCLC and RLIN might result in additional, valuable URLs because, in her work as a serials cataloger, she frequently had consulted these databases for e-journal records and found them useful. A strategy for assessing impact after collecting the URLs from the various directories and catalogs was as yet undecided: Potentially, one could search for links to all URLs discovered, all functioning URLs, all functioning and current URLs, or simply the most frequently listed URLs. Given this range of options, it was decided that the study's goal would be to discover how many URLs could be uncovered by using these sources and to tabulate, for each URL, how many sources included it, whether it worked, and if it worked, whether it led to a current site for the e-journal in question. The resulting investigation yielded interesting data on the usefulness of online directories and catalogs in providing access to e-journals and on the scattered nature and fluidity of e-journals.

Research Questions

The specific research questions addressed in this article are:

- *E-journal coverage:* What is the coverage of each directory and the union catalogs? That is, how likely is it that a researcher will find a given peer-reviewed e-journal listed in each source?
- *Accuracy:* How accurate are the URLs listed in each directory or catalog? Do they lead to functioning sites?
- *Currency:* To what extent do the sites lead to the most recent issue of the e-journal?
- *Agreement:* How diverse are the URLs listed in the sources? How much overlap is there among listings? Can the URLs listed in them be pooled to derive a list of the most commonly recognized URLs for each e-journal title?
- *URL coverage:* What is missing from the directories and catalogs? Are there additional obvious, significant URLs that a visit to listed sites will uncover? How many URLs are listed for each title?

Methodology

To locate authoritative or widely recognized URLs for the thirty-nine e-journals, searches for each e-journal title were conducted in July 1997. Four widely recognized online directories were searched: the 1996 electronic edition of the *ARL Directory of Electronic Journals and Newsletters* (http://arl.cni.org/scomm/edir/), the

TABLE 1
Coverage of E-journal Titles and URLs in E-journal Directories and Catalogs

	Source (Directory or Catalog)					
	ARL Directory	CIC Index	Univ. of Houston	Ejournal	RLIN	OCLC
Number of titles included* (N = 36)	33	26	21	25	31	32
Percentage of titles included*	91.7	72.2	58.3	69.4	86.1	88.9
Total number of URLs listed	40	46	21	26	93	86
Mean number of URLs per title	1.2	1.8	1.0	1.0	3.0	2.7

* Only entries that included http, gopher, ftp, or telnet URLs were counted. In RLIN and OCLC, some titles had entries that listed no URLs or provided only information regarding print or listserv access; these were not counted.

CIC Electronic Journals Collection Index (http://ejournals.cic.net/index.html), the University of Houston listing of *Scholarly Journals Distributed via the World-Wide Web* (http://info.lib.uh.edu/wj/webjour.html), and Ejournal, the WWW Virtual Library electronic journals list (http://www.edoc.com/ejournal/academic.html). The last directory was chosen because of the frequency with which it appeared in the "link:" searches on the first ten e-journals in the exploratory phase of the study; further investigation proved it to be comparable in its coverage of the titles to the CIC Index, and it offered a non–U.S. source of directory information.

If the server automatically routed the user to a working URL, it was considered to be functional because it led directly to the e-journal.

All http, gopher, and ftp URLs were collected from the directories for each e-journal listed. Each URL then was checked to see if it led to the e-journal home page (functionality); if it did, the issue number and/or date of the latest available issue at the site was noted, as was the ISSN for the e-journal, if one was provided.

Searches were undertaken subsequently in the RLIN and the OCLC Worldcat databases, by ISSN (if available) and title. All records that provided URLs were collected from these databases; all http, gopher, or ftp URLs for each title were compiled, and duplicates were removed. The CIC URLs appeared frequently in both databases but were not included in the final tabulations because they simply linked to entries in the CIC directory and did not lead directly to home pages (furthermore, many of these URLs led to incorrect entries in the CIC directory). All the additional URLs listed in RLIN and OCLC were checked for functionality and currency. URLs were cut and pasted directly from the sources into a word-processing document and checked by either clicking on them directly in a Windows 95 environment or cutting and pasting them into Netscape Navigator, thereby reducing the possibility of transcription error.

An additional visit to the most current Web sites was made to check for obvious new or additional URLs (such as mirror sites) not listed in the directories or catalogs. During this visit, e-mail addresses also were gathered for the editor, technical editor, Webmaster, or "comments" contact person who might be able to provide insight into what should be considered the "real" home page of the e-journal. When the directories and visits failed to yield any functioning sites (as they did in three cases), Web searches were under-

TABLE 2
Functionality and Currency of URLs for the Thirty-six E-journal Titles

	Source (Directory or Catalog)					
	ARL Directory	CIC Index	Univ. of Houston	Ejournal	RLIN	OCLC
Total number of URLs listed	40	46	21	26	93	86
Total number of URLs that are functional*	25	41	21	20	60	59
Percentage of URLs that are functional	62.5	89.1	100.0	76.9	64.5	68.6
Total number of functional URLs that are current**	23	33	20	16	47	46
Percentage of URLs that are functional and current	57.5	71.7	95.2	61.5	50.5	53.5

* Functional URLs lead directly to the home page or main entry point of the e-journal in question.
** Current URLs lead to sites that include the most recent known issue of the e-journal in question.

taken using Internet search engines to try to locate a home page.

As the searches were performed, it was discovered that one title (*PSYCGRAD, the Psychology Graduate Student Journal*) was defunct; no http, gopher or ftp URLs were found in any of the directories or catalogs for this title, and e-mail communication with the coordinator of the PSYCGRAD Project confirmed the e-journal's demise. Therefore, results for this title are not included in the analysis of data. Two other titles also proved problematic. The *Online Journal of Current Clinical Trials* and the *Online Journal of Knowledge Synthesis for Nursing* were available only to paid subscribers. For this reason, the directories and catalogs did not provide URLs that led to what might be considered home pages for these journals, but only to the gateways through which they were accessible to subscribers, or to sample issues. Thus, these titles were different in a significant way from the others, which were freely available on the Internet; their home page links were not provided by the directories because they were not directly accessible to users. These two titles also are excluded from the analysis. Thus, the data to be provided next are for thirty-six titles.

Findings

A search of the different directories and catalogs revealed different levels of coverage, comprehensiveness, and accuracy for the thirty-six titles (see table 1). The ARL directory listed the highest number of titles (33) but rarely listed more than one URL per title. The CIC directory included fewer titles (26) but listed an average of 1.8 URLs per title. The University of Houston and the Ejournal listings were much more selective, listing exactly one URL per title. However, these sources included fewer of the e-journals in the study sample than the other two directories did.

The union catalogs (RLIN and OCLC) represent a different approach. Their coverage was good, comparable to that of the ARL directory (thirty-one and thirty-two titles found, respectively). Moreover, because these databases consist of records contributed by catalogers at participating libraries, many of the records listed multiple entry points and formats, reflecting an effort by catalogers to provide an accurate description of the various entry points to a title. In many cases, there were multiple records in the databases for the same title, created at different times. The mean number of URLs per title listed in

TABLE 3
Summary of Problems with Nonfunctional URLs

Type of Problem	Number of URLs
"No response" message	15
Message indicating file, URL, or path not found	12
E-journal not found at site, message indicating move	7
E-journal not found at site, no message	6
"Server not found" message	4
Message indicating server has moved	1
Gopher or FTP error message	2
System timed out	1
User access denied	1

OCLC and RLIN was 2.7 and 3.0, respectively (excluding entries for the CIC Index). Thus, entries for the e-journals in the sample are most likely to be found in ARL, RLIN, or OCLC, with many more URLs found in the latter two sources.

It might be hypothesized that the information contained in the collectively constructed union catalogs also would be less accurate because it is more difficult to maintain a large, decentralized catalog than a smaller, more tightly controlled directory. This proved to be the case. Each URL was checked for functionality. By definition, a "functional" URL led the user directly to what could be considered the home page or main entry point of the e-journal in question. URLs that yielded error messages (e.g., "file not found," "server not found," "object not found," "path not found," "no response") were considered nonfunctional, as were those that led to pages that were not home pages of the e-journal. Examples of such pages include pages on which the e-journal did not appear, directories or personal home pages on which the e-journal was listed as one of many items, and pages from which the e-journal had moved. If the server automatically routed the user to a working URL, it was considered to be functional because it led directly to the e-journal. A URL was considered current if the latest issue found at the site was the most recent issue found at any site listed in the six sources checked.

One might expect a trade-off between coverage, functionality, and currency; and this was indeed the case. The functionality and currency of the URLs provided for the thirty-six e-journals are summarized in table 2. As expected, the union catalogs had the lowest percentage of working, current URLs (50.5% and 53.5%), although they still had (by far) the highest number of working, current URLs; a researcher interested in a comprehensive listing of access points would certainly want to consult them. The University of Houston directory, although listing relatively few titles and only one URL per title, had impressively accurate entries (all URLs were functional, and the site pointed to by the sole noncurrent URL was only one issue behind the most current site). The CIC directory offered a reasonable combination of multiple listings with an acceptable rate of functioning, current URLs; 89.1 percent of the URLs listed in the CIC directory worked, and nearly three-fourths of these were current.

Table 3 summarizes the kinds of problems encountered. The most common of these was the "no response" message from the browser (fifteen cases). In twelve cases, the object was not found on the requested server. In addition, there were several other less frequently occurring problems (see table 3). It should be noted, however, that these URLs were not systematically checked more than once.

One strategy under consideration in the larger study was to search only for links to http versions of the e-journals. Although gopher and ftp e-journal sites still can be found on the Internet, virtually all the surviving e-journals have migrated to http, continuing the trend noted

TABLE 4
Functionality and Currency of Access Methods Included in the Six Sources

	Source (Directory or Catalog)					
	ARL Directory	CIC Index	Univ. of Houston	Ejournal	RLIN	OCLC
Number of http URLs listed	31	27	21	19	41	41
Number and percentage of http URLs that are functional and current	22 (71.0%)	26 (96.3%)	20 (95.2%)	13 (68.4%)	30 (73.2%)	30 (73.2%)
Number of gopher URLs listed	4	13	0	7	27	22
Number and percentage of gopher URLs that are functional and current	0 (0.0%)	5 (38.4%)	*	3 (42.9%)	8 (29.6%)	8 (36.4%)
Number of ftp URLs listed	4	6	0	0	24	23
Number and percentage of ftp URLs that are functional and current	0 (0.0%)	2 (33.3%)	*	*	9 (37.5%)	8 (34.8%)
Number of telnet URLs listed	1	0	0	0	1	0
Number and percentage of telnet URLs that are functional and current	1 (100.0%)	*	*	*	0 (0.0%)	*
Total number of URLs listed	40	46	21	26	93	86
Total number and percentage of URLs that are functional and current	23 (57.5%)	33 (71.7%)	20 (95.2%)	16 (61.5%)	47 (50.5%)	46 (53.5%)

* None listed

in Harter and Kim.[9] However, most of the six sources consulted still list gopher, ftp, and other modes of access to the e-journals. In many cases, these sites have been abandoned because the publishers have transferred their e-journals to the http format. All the directories except for the University of Houston listing, and especially the RLIN and OCLC catalogs, still listed many non-http URLs (see table 4). However, not surprisingly, the http URLs were much more likely to be functional and to link to currently maintained sites. Both the absolute numbers and percentages of functional and current URLs drop precipitously when gopher, ftp, and telnet modes of access are considered. For example, if only http formats are considered in the CIC directory, its accuracy is an impressive 96.3 percent; the inclusion of its listed gopher and ftp URLs brings the overall accuracy rate down to 71.7 percent. In all the sources consulted, users are much more likely to find current issues of e-journals by following the http URLs.

Table 5 combines the data for the six sources with duplicate URLs removed. That is, table 5 reports data for unique URLs only. The percentages of functional and current URLs are much lower in table 5 than in table 4 because the functional and current URLs tend to appear in several sources, whereas nonfunctional, noncurrent URLs tend to appear in only one or two of the six sources. The percentages are not good. Only about two-thirds of the http URLs and fewer than one-third of the gopher and ftp URLs are both functional and current.

The number of URLs listed in the six sources for each e-journal title varies from

TABLE 5
Combined Data for Functionality and Currency of Access Methods

	Access Method				
	http	gopher	ftp	telnet	total
Number of titles for which this URL type is listed (N=36)	33	26	21	2	–
Total number of unique URLs listed	81	36	29	2	148
Total number of unique URLs that are functional and current	54	10	9	1	74
Total percentage of unique URLs that are functional and current	66.7	27.8	31.0	50.0	50.0

a minimum of one (for three titles) to sixteen (for one title) (see table 6). The median number found in all sources was four, which was also the mode. The e-journals listing nine and sixteen URLs were *Postmodern Culture* and *Psycoloquy*, respectively. Both of these titles were established in 1990 and thus have had a number of years to build a trail of URLs. The reference sources included defunct ftp and gopher URLs and a variety of http URLs for *Postmodern Culture*. *Psycoloquy*, whose editor acknowledges (and seems to encourage) multiple modes of access and multiple mirror sites, has the greatest number of entries in the sources.

TABLE 6
Frequency Distribution: Number of URLs per Title

No. of URLs per Title	No. of Titles
0	0
1	3
2	6
3	4
4	12
5	7
6	1
7	1
8	0
9	1
10	0
16	1

The initial motivation for this study was to identify the URLs leading to the home page of a set of electronic journals so that "link:" searches could be conducted on them to determine how many and what kinds of Web pages were linked to each e-journal. At this point, a possible strategy under consideration was to pool the findings from the six sources to generate a "most recognized" or "most common" listing of URLs for the e-journal titles in question and to perform "link:" searches on that subset of the URLs. The authors had found several URLs for most titles (table 6), and in many cases, several different URLs led to a current version of the e-journal home page. They hoped that by comparing the URLs listed in the reference sources, they might be able to identify a more compact set of URLs that were widely identified as leading to the e-journals.

The six sources were checked for agreement on the URLs listed (see table 7). For six of the titles, the same current, functional URL appeared in all six sources. For nine other titles, the same current, functional URL showed up in either four or five of the sources. In fact, for thirty-two of the thirty-six titles, a "most frequently listed" functional and current URL was easily derived; only four titles had "ties" for the URL most frequently listed in the sources. Therefore, it might be possible to choose the most commonly recognized functional and current URL and search for links to it. However, to do so would mean

TABLE 7
Number of Sources in Which the Most Commonly Occurring Functional and Current URL Appears, for Each of the Thirty-six E-journals

No. of Sources	No. of E-journal titles
0	4
1	3
2*	6
3*	8
4	5
5	4
6	6

* tie among URLs for 2 e-journal titles

that other significant URLs would be ignored. For instance, a single current and functional URL for *Architronic* (http://www.saed.kent.edu/Architronic/) appeared in four of the six reference sources, but another URL (http://www.saed.kent.edu/Architronic/homepage.html) appeared in two sources and a third (http://arcrs4.saed.kent.edu/Architronic) appeared in one directory. Links have been made to all of these URLs. By excluding a URL because it is listed in, say, two sources instead of three, valuable information on an e-journals impact may be lost.

After site visits were undertaken to assess whether the URLs listed in the six sources were working and current, the sites were examined for indications of other obvious URLs leading to home pages or entry points for the e-journals. In addition, at the most current sites, addresses of the editors, technical editors, or Webmasters were gathered to solicit additional URLs, and an e-mail message was sent in early August to contacts for thirty-four of the thirty-six e-journals. The message requested assistance in identifying all existing URLs (http, gopher, ftp) that might be considered entry points to the e-journals. Finally, in the two cases where no listed URLs could be accessed and a visit yielded no clues as to the e-journal's location (*Gassho* and *Ulam Quarterly*), a Web search was conducted on the e-journal titles to see if a current, functional URL could be found.

All these tactics yielded additional URLs. In all, eighty-three additional URLs for the thirty-six titles were identified during visits to the sites (see table 8). Many of them were mirror sites not listed in the directories and catalogs (although OCLC did include some mirror sites in its records). Others were variations on the home page URL that appeared when "home" was selected from somewhere in the site—for instance, http://www.ams.org/journals/bull/home.html as opposed to http://www.ams.org/journals/bull/. Although seemingly minor, this variation is important when considering specific URLs to which Web pages may be linked. Eighty-three percent of the URLs gathered in this phase of the research were working and current (all but fourteen).

The e-mail messages sent to the e-journal contact people resulted in responses regarding twenty of the e-journals (a

TABLE 8
Additional URLs Discovered During Site Visits

Type of URL	No. of URLs	No. and Percentage of URLs That Are Functional and Current
Mirror site	53	42 (79.3)
Variation on home page URL	6	6 (100)
New home page	3	3 (100)
Current archives	3	3 (100)
Miscellaneous additional listings	18	15 (83.3)
Total	83	69 (83.1)

58.8% return rate). Eight previously undiscovered URLs were identified by the respondents. Several believed that the phrase "entry points" used in the e-mail message referred to links made from other sites to the e-journals, highlighting the difficulty of identifying what constitutes an entry point in the fluid electronic medium. Some suggested that a Web search would uncover the entry points; others believed that it probably was impossible to identify all the sites where the e-journal existed. (On the basis of this exploratory study, the authors concur with this last assessment.)

It is clear that the http URLs, representing the "newer" mode of access, are more likely to work than the gopher or ftp URLs.

For three of the thirty-six e-journal titles, no http addresses were listed in the directories or catalogs, and the issues that were examined appeared dated. A Web search on these titles revealed that two journals (*Education Research & Perspectives* and *Ulam Quarterly*) were available at http URLs, and one (*Online Modern History Review*) was in the process of moving to http access.

Conclusions

The directories and catalogs the authors studied appear to fill two different and useful functions, with the best directories (UH and CIC) providing one or two working, current URLs to e-journals and the catalogs (OCLC and RLIN) providing multiple records and multiple URLs (and a greater chance that these URLs would not work). There is a need for both kinds of sources. It is clear that the http URLs, representing the "newer" mode of access, are more likely to work than the gopher or ftp URLs. There may be no reason for the directories to continue listing these modes of access if their purpose is to direct the user to working, current home pages for e-journals.

The value of cataloging Internet resources has been debated, given the rapidly changing nature of the medium.[10] For a researcher attempting to gather URLs, the catalogs are a useful resource. However, the accuracy of their listings is problematic (only about half of all URLs listed work and are current, with that percentage rising only to 66.7% for http URLs). It is possible that technological advances will help to resolve some of the difficulties that are created by shifting URLs. Eventually, uniform resource names (URNs) may provide persistent, location-independent, unique "names" for Internet resources, similar to ISBNs or patent numbers, that then could be mapped to URLs. In the meantime, resolver software (such as OCLC's Persistent URL, or PURL) is being used by some Internet publishers who wish to maintain persistent identifiers for their resources, regardless of current physical location.[11]

Although the catalogs list more access points to e-journals than the directories, they are far from comprehensive: Some of the URLs listed in the directories were not in the catalogs, and visits to e-journal sites plus responses from e-journal contact people resulted in ninety-one additional URLs. Even if mirror sites are not counted—and perhaps they should not be—thirty-seven additional URLs were uncovered that were not listed in OCLC or RLIN, about one per title. As the Internet is currently structured, most e-journals exist at multiple URLs, and it probably is absurd to hope for a "comprehensive" listing of URLs in any source. Although gopher and ftp URLs seem to be fading in favor of http URLs, many titles still maintain multiple modes of access, and several titles have multiple mirror sites. While it may be possible to use reference sources to identify the most commonly listed URL for a given e-journal, this is usually not the only current, functional URL listed in the sources and almost never the only current, functional URL in existence.

Some e-journal editors seem to maintain tight, centralized control. For instance, *Interpersonal Computing & Technology* appears to exist in one and only one place (http://www.helsinki.fi/science/optek). Others have chosen to provide users with multiple modes of access at multiple sites, such as *Psycoloquy*, for which sixteen URLs were listed in the six sources and another seventeen were found through visits and correspondence (including multiple spellings of the journal's name at an ftp site to aid poor spellers and typists). Well-labeled "central servers," with carefully listed and maintained mirror sites, seem to offer the best of both worlds. The journals contained in the Electronic Library of Mathematics of the European Mathematical Society (http://www.emis.de/journals/) exemplify this approach. These journals are available from a number of EMIS mirror sites worldwide; mirror sites are generally kept current, and clear pointers exist at every site to the central server and other mirror sites.

Although the Internet epitomizes decentralization, the ability to identify an e-journal's central, "official" location is important; it should matter to librarians trying to provide access to the most current issues of e-journals, to e-journal editors trying to maintain readership, and to scholars wishing to publish in an authoritative source whose impact can be measured. E-journal producers can help the situation by removing dated files whose contents are duplicated elsewhere, by "bouncing" users from old sites to new ones (or at least leaving a forwarding address), by informing major directories of changes of address, and by clearly listing mirror sites and alternate URLs on their home pages. Those seeking to maintain directories of e-journals can improve the situation by checking URLs periodically (using software and even checking in person to make sure that the URL that appears to function is not really a page with a forwarding address). The fluid and decentralized nature of e-journals does not have to mean chaos.

Notes

1. William A. Katz, *Introduction to Reference Work*, 7th ed. (New York: McGraw-Hill, 1997), 45–46, 106.

2. For a discussion of best-selling Internet directories, see, for example, Paul Hilts, "Yahoo! No More Catch 22," *Publishers Weekly* 242 (Oct. 1995): 32.

3. More extensive treatment of these and other challenges facing e-journal catalogers can be found in Kristin H. Gerhard, "Cataloging Internet Resources: Practical Issues and Concerns," *Serials Librarian* 32:1/2 (1997): 123–37; Eric Lease Morgan, "Adding Internet Resources to Our OPACS," *Serials Review* 21, no. 4 (1995): 70–72. Janet Swan Hill effectively highlights some of the issues involved in cataloging Internet resources in "The Elephant in the Catalog: Cataloging Animals You Can't See or Touch," *Cataloging & Classification Quarterly* 23, no. 1 (1996): 18–24.

4. For descriptions of some of the efforts to build and maintain e-journal directories, see Robert D. Cameron, "Not Just E-Journals: Providing and Maintaining Access to Serials and Serial Information through the World-Wide Web," *Serials Librarian* 23, no. 3/4 (1996): 209–22; Bonnie McEwan and Mira Geffner, "The Committee on Institutional Cooperation Electronic Journals Collection (CIC-EJC): A New Model for Library Management of Scholarly Journals Published on the Internet," *Public-Access Computer Systems Review* 7, no. 4 (1996), available at http://info.lib.uh.edu/pr/v7/n4/mace7n4.html .

5. The e-journal access problems and issues are discussed in detail in Stephen P. Harter and Hak Joon Kim, "Accessing Electronic Journals and Other E-Publications: An Empirical Study," *College & Research Libraries* 57 (Sept. 1996): 447–49. The citation study of which this is a part is Stephen P. Harter's "The Impact of Electronic Journals on Scholarly Communication: A Citation Analysis," *Public-Access Computer Systems Review* 7, no. 5 (1996): 5–34, available at http://info.lib.uh.edu/pr/v7/n5/harter.7n5 .

6. Harter and Kim, "Accessing Electronic Journals and Other E-Publications," 453.

7. Since this study was completed, the ARL has released a revised edition of its directory (7th edition, available at http://www.arl.org/scomm/edir/).

8. MacEwan and Geffner, "The Committee on Institutional Cooperation Electronic Journals Collection (CIC-EJC)."

9. Harter and Kim, "Accessing Electronic Journals and Other E-Publications," 443.

10. A quick summary of some of the arguments for and against cataloging Internet resources appears in Erik Jul, "Why Catalog Internet Resources?" *Computers in Libraries* 16 (Jan. 1996): 8–9. For an article that more directly addresses the issues surrounding the cataloging of e-journals, see Ellen Finnie Duranceau, ed., "Cataloging Remote-Access Electronic Serials: Rethinking the Role of the OPAC," *Serials Review* 21 (winter 1995): 67–77, which brings together the viewpoints of five librarians on these issues.

11. More detailed explanations of URNs and PURLs can be found in the Library of Congress National Digital Library Program's "The Relationship between URNs, Handles, and PURLs" (1997), available at http://learning.loc.gov/ammem/award/docs/PURL-handle.html, and in Stuart Weibel, Erik Jul, and Keith Shafer, "PURLs: Persistent Uniform Resource Locators," (1996), available at http://purl.oclc.org/OCLC/PURL/SUMMARY .