The topic of electronic journals (e-journals) dominated the serials literature from 2000 to 2003. This review is limited to the events and issues within the broad topics of cost, management, and archiving. Coverage of cost includes such initiatives as PEAK, JACC, BioMed Central, SPARC, open access, the "Big Deal," and "going e-only." Librarians combated the continued price increase trend for journals, fueled in part by publisher mergers, with the economies found with bundled packages and consortial subscriptions. Serials management topics include usage statistics; core title lists; staffing needs; the "A-Z list" and other services from such companies as Serials Solutions; "deep linking"; link resolvers such as SFX; development of standards or guidelines, such as COUNTER and ERMI; tracking of license terms; vendor mergers; and the demise of integrated library systems and a subscription agent's bankruptcy. Librarians archived print volumes in storage facilities due to space shortages. Librarians and publishers struggled with electronic archiving concepts, discussing questions of who, where, and how. Projects such as LOCKSS tested potential solutions, but missing online content due to the Tasini court case and retractions posed more archiving difficulties. The serials literature captured much of the upheaval resulting from the rapid pace of changes, many linked to the advent of e-journals.

Serials literature from 2000 through 2003 was dominated by the topic of electronic journals (e-journals). This seemed to be a natural correlation to the rise in academic library expenditures on e-journals, documented by Association of Research Libraries (ARL) reports. The data from the reports show that the median expenditure on electronic serials went from $156,754 in 1994-95, to $571,790 in 1998-99.¹ Cost remained a significant concern, as libraries increased expenditures on e-journals in addition to maintaining print subscriptions. A longstanding debate over ownership versus access filtered down to questions regarding the sustainability of existing pricing models for electronic resources, which included consortial purchasing and subscriptions to large collections of titles. Both the electronic format and changing models of scholarly communication brought expectations of lower prices. The volatility in the field, with numerous mergers of publishers and vendors, raised concerns about price increases and difficulties libraries faced keeping acquisitions and cataloging records in step with the volume and rapidity of the changes. Librarians and library staff needed different competencies to work with electronic resources. The newer responsibilities, such as licensing and maintenance of hyperlinks in the catalog, increased with the rise in e-journals. Without an increase in personnel, librarians and staff strained to keep up with the additional workload. Those with growing physical collections wondered if they should turn to more electronic resources as part of a solution to lack of space in addition to cost savings. As desire for e-journals increased along with financial pressures, librarians shifted from print
plus online to electronic-only subscriptions. Concern grew over missing content and preservation of nonprint materials, resulting in discussion of the various obstacles in archiving electronic information. E-journals presented both advantages and difficulties to librarians. Much of the literature was written to share potential solutions to problems or to advise colleagues of tools or management practices being developed. Recorded initiatives, projects, and market trends in American academic libraries showed the intensity of this effort in many areas of librarianship. Certain major events and research activities of significance did not appear in peer-reviewed periodical literature, and this author included other sources to provide the fullest context possible for the time period and topics covered. The scope of this review is limited to three areas in order to restrict overlap with potential or existing reviews of collection development, cataloging, preservation, and technical systems. The three areas addressed in this literature review are cost, management (including topics relative to collection development and technical services), and archiving.

Cost

From 2000 to 2003, librarians and publishers tested methods of delivery and pricing for e-journal content while costs continued to rise. Dingley's examination of periodical prices showed a persistent inflation rate, with increase percentages of 8.3, 7.9, and 7.7 for 2001, 2002, and 2003, respectively. Librarians explored a variety of cost control methods that included bulk purchasing resulting from either a number of titles or a number of libraries subscribing together; new publishing initiatives from nonprofit groups; a new publishing model called open access; and deduplication of formats by canceling print subscriptions in favor of the electronic version. Publisher mergers, questions about the sustainability of the new publishing models, and delays in availability of e-journal issues complicated these cost-control efforts. A large number of papers in the literature illustrated these activities, and all could not be represented in this review. The author attempted to choose papers that illustrated pivotal conclusions, events, or stages of development relative to cost control.

In 2000, librarians perceived subscriptions to large collections of titles, variously known as bundled packages or the Big Deal, mostly as a way to get more content with flat or reduced budgets. Librarians also subscribed to journals through consortia to gain savings. In a combination of the two approaches, the OhioLINK consortium demonstrated the benefits of the Big Deal by simultaneously expanding patron use of journals (tripled over print on average) and saving millions of dollars compared to the cost of adding subscriptions for the titles used. Sanville's statistics for the OhioLINK Electronic Journal Center (EJC) usage after twenty-six months of operation indicated that, "On average each Ohio university uses 3.5 times more titles than they previously held in print, and 51% of downloaded articles were not available in print on each campus." Sanville wanted to expand access with both low- and high-priced publishers equally, and felt that collection development methods for journals needed to be re-examined in the context of this new environment, but he did not think that the "single, state-based library consortium" was "empowered to immediately change the market's economic fundamentals that many feel are out of balance."

In another experiment to expand access electronically, but with multiple pricing models, Elsevier Science Publishers collaborated with twelve libraries in the Pricing Electronic Access to Knowledge (PEAK) project. Button reported three types of pricing in the experiment: publisher-selected content for $4 per article; content by the bundle at $548 for 120 articles; and pay-per-view at $7 per article. Haar of Vanderbilt University reported statistics demonstrating that the university's patrons did not read articles from 25 percent of the titles in PEAK to which Vanderbilt also subscribed in print; the university did not subscribe in print to fifteen of the thirty most heavily used titles (under-scoring the underfunded subject of engineering); less than two percent of the total journal content available online was used; and the articles that were used were viewed an average of 2.7 times. Haar observed that the experiment had been worthwhile. McKay suggested that pay-per-view could be a patron self-service alternative to interlibrary loan.

One significant project varied from OhioLINK's bundled Big Deal, but also sought to save money through consortial purchasing. In this initiative, the California State University worked with a subscription agent, EBSCO, to arrange licensing of a customized collection of electronic journals on behalf of a multilibrary system in the Journal Access Core Collection (JACC) project. JACC differed from other consortial arrangements primarily by the customization, or selection, of titles instead of acceptance of a publisher- or vendor-defined collection. The project attempted to address many of the strong concerns of the time, including archiving, a question looming large as libraries were reaching a point of heavy investment into e-journals.

While bundled collections or the Big Deal were initially touted as a means of getting more bang for the buck (measuring cost per unit), they were later disparaged by some librarians as strangling an institution's ability to select appropriate titles from a wider array of publishers. Some librarians also feared a homogenization of titles held by multiple libraries because of consortial bundles, but in 2001, Peters indicated that most academic libraries spent 15 to 20 percent of their entire materials budget on e-resources, with only a fraction of that being for consortial spending, and
thus it would be a long time before such a homogenization could occur.\textsuperscript{11} Peters summed up various published opinions of the time that were against and for the big deal:

[Kenneth] Frazier and [Robert] Michaelson have articulated a position that could be called the traditional model of collection development: It is possible to know “a priori” what a given community of users wants and needs, and it is best, whenever possible, to select information items (e.g., books and journals) at the title level. [Ross] Atkinson and various writers associated with OhioLINK and other consortia (e.g., Tom Sanville and David Kohl) have articulated an untraditional model for electronic collection development: Provide access to as much electronic information as possible, usually by selecting whole chunks of information, level the playing field so that all academic users have access to the same basic core collection, then analyze usage carefully to determine the interests and needs of a user population. Although these two positions seem antithetical, they probably will continue to co-exist—more or less peacefully—for the near future.\textsuperscript{12}

In winter 2003, several well-known libraries rebelled at Big Deal pricing, which they considered exorbitant. California institutions, Cornell, and Harvard all publicized plans to pull back from Elsevier’s Science Direct package.\textsuperscript{13} Bundled packages occasionally swelled as the result of a merger and, according to an analysis by economist McCabe, “quality and cost-adjusted price increases have been substantial over the past decade and . . . past mergers have contributed to these price increases.”\textsuperscript{14} Stankus reported merger activity that took place between 2000 and 2003: Taylor & Francis bought Gordon & Breach; Reed Elsevier bought Harcourt and the Academic Press IDEAL package; Blackwell Publishing and Blackwell Science were merged; and Wolters-Kluwer bought SilverPlatter.\textsuperscript{15} He also saw one significant failure, when Taylor and Francis withdrew an offer for Blackwell, and one significant success, with the Candover and Cinven purchase of both Kluwer Academic Press and Springer.\textsuperscript{16}

Group-based efforts to increase competition to commercial publishers included the Scholarly Publishing and Academic Resources Coalition (SPARC) and BioOne. SPARC was developed by the Association of Research Libraries (ARL) and supported by membership of academic institutions. SPARC had several programs, with a focus on scientific scholarly communication, but perhaps the best known was the Create Change initiative responsible for the launch of new journals designed to compete, at lower prices, with existing titles having the same scope.\textsuperscript{17} Supporting the initiative, the former editorial board of The Journal of Academic Librarianship, whose members had resigned when Elsevier took over the title, created the journal portal: Libraries and the Academy.\textsuperscript{18} BioOne, which was formed by “collaboration among scholarly societies, universities and university libraries, and a specialist in scholarly journal production,” held the view that “scientific literature should be priced as a public good,” and offered a database of journals in biology.\textsuperscript{19} “BioOne was founded to provide participating journals an alternative to affiliation with commercial publishers, and to foster the continuing financial health of the small societies.”\textsuperscript{20} Fyffe and Shulenburger explained that BioOne shared 50 percent of revenue with the societies and kept administrative and production costs low.\textsuperscript{21} They also recommended that “societies should be developing diverse streams of income and diverse member services” and “publishers should be developing additional sources of financial support beyond subscription costs.”\textsuperscript{22}

Another group-promoted shift in the market, open access (online content free to the user via the Internet), gained strength in late 2003, when SPARC announced a partnership with the Public Library of Science (PLoS), following up on a statement previously issued by ARL and SPARC that lauded “legislation by Congressman Martin Sabo (D-MN) to place articles reporting on federally funded research into the public domain (H.R. 2613, the Public Access to Science Act of 2003).”\textsuperscript{23} PLoS, a nonprofit organization supporting free access to scientific information, began publishing its first open access e-journal, PLoS Biology, in 2003. BioMed Central, another open access model, had 396 institutional memberships as of November 2003, showing “amazing growth.”\textsuperscript{24} Wilson emphasized that open access, often having copyrighted materials, does not equate with public domain.\textsuperscript{25} With open access, information producers rather than the consumers carried the cost of the publishing process. In some models of open access, the author paid to be published, and in others an organization, such as a university, bore all or part of the cost on behalf of member authors. Falk recorded concerns of critics that Sabo’s “bill could hamper academic publishing and nonprofit publishers,” and “it might negatively affect research funding, academic research and publishing.”\textsuperscript{26} Publishers expressed concerns, especially about the sustainability of the open access model. Morris listed cost-contributing items, such as editors, communications, preservation and maintenance, customer support, and linking.\textsuperscript{27} Butler cited “considerable costs for staffing and administration.”\textsuperscript{28} Both authors noted another obstacle to a transition to open access: persuading the information producers to participate while the subscription model was still in place. Even if institutions or organizations subsidized the authors’ costs, the authors would be taking a risk by choosing the new alternative over the established, prestigious journal that could assure career
success. Prosser reviewed some of the same difficulties and recommended a hybridization of existing journals as a means to promote the transition, meaning that the publisher of well-known titles could offer the author a choice of paying for open access or having the traditional free-of-charge, closed publication. Prosser proposed that authors would be motivated to make the change because higher citation rates to their papers would come from open access. Falk reported that the Directory of Open-Access Journals was created to promote use of open access journals that had “an appropriate quality control system,” and that there were 350 such journals at the time.

In addition to bulk purchasing and group initiatives for affordable publications, the longstanding cost-control method of cancellation continued to be used. From 2000 to 2003, cancellation projects often focused on reducing duplication of print and electronic formats, using specific criteria or use statistics, or both. (Use statistics are addressed later in this paper.) In the case study by Sprague and Chambers, the authors found shortcomings in database versions of print journal titles when examining the databases for currency, coverage, representation of graphics, and stability. Rupp-Serrano, Robbins, and Cain wrote a detailed paper covering a full range of important criteria in making format choices. They grouped criteria into six areas: licensing, provider (reliability and duplication), local politics, publication structure, technological considerations, and local resources (money, space, and staffing). Kaylan’s case study, an examination of all of the library’s subscriptions in both print and electronic format, began with the premise that print subscriptions would be cancelled, but resulted in the retention of selected print titles when the embargo period was a year or more in the database version.

Librarians witnessed the rise of embargoes on the aggregated electronic collections of multiple publishers supplied by such distributors as EBSCOhost and Proquest. An embargo determined by the publisher can delay the release of current issues to databases by as much as a year after initial publication. After having imposed lengthy embargos previously, Sage ended contracts with EBSCOhost and Proquest because the royalties from aggregators were not enough to sustain journal publication. Sage continued to offer “free” electronic access with print subscriptions through a variety of third-party platforms, including Ingenta and EBSCOhost Electronic Journals Service (previously named EBSCO Online). As explained by Brooks, senior vice president of sales and marketing at EBSCO Publishing, a publisher could not have stayed in business without protecting the direct print or e-journal subscription revenue via embargo because databases were priced for the aggregation of many titles, resulting in a lesser cost per title and subsequently a smaller revenue to the publisher from the database, even if the aggregator “shared every penny.” Brooks concluded that because embargoes encouraged publishers to participate in databases, they enabled patron access to titles the library might not have had other than through the aggregation or to older volumes not included in the library’s current electronic subscription.

In addition to keeping print subscriptions due to embargoes in databases, librarians had also continued with print to address archiving concerns, but this practice of dual format subscriptions began to change after the events of September 11, when state economies plummeted across the nation. Librarians began to realize that electronic publication would not result in lower prices. In 2001, Meyer published the results of several statistical tests that predicted continued increases in prices and monopoly power as publishers introduced electronic versions of titles. The tests had an extremely high degree of reliability (correct more than 99 percent of the time with the monopoly power test). A table of twenty titles, including both commercial and society publishers, listed a significant difference of more than 100 percent between the institutional price charged by the publisher and the price predicted by the model. Meyer offered this model as a tool to “reduce the guesswork implicit in the price analysis” used in selection. As choices had to be made due to the financial constraints, librarians began to cancel print subscriptions in favor of keeping the electronic versions, known as “going e-only.” The shift to electronic subscriptions raised an interesting question at the 2002 ALA Annual Conference, which included a program by the Association for Library Collections and Technical Services (ALCTS) Committee on Library Materials Cost Index titled “Predicting Publication Prices: Are the Old Models Still Relevant?” While papers based on presentations given at the program by Bluh, Neal, and Call cited various causes for a less significant role for publication price indexes, a common reason given was the increased interest in electronic resources, along with the fact that the traditional materials pricing indexes had not included electronic resources or considered consortial pricing. A few months after the Conference, another prediction caught the attention of librarians. By October 2002, “The hot piece of paper circulating at the recent Charleston Library conference was the front page (only) of a recent Morgan Stanley Equity Research (Europe) report entitled ‘Scientific Publishing: Knowledge is Power.’” The report featured Reed Elsevier and Wolters Kluwer, and forecasted “industry growth slowing from 8% in 2001 to 3% in 2002 as library budgets came under pressure.” The report also purported that both libraries and publishers should benefit from going e-only. Morgan-Stanley calculated that scientific publishers could anticipate an estimated 16 percent improvement in profitability per customer going e-only. The report furthermore projected that “Reed is likely to continue to outperform the market . . .”
Prior to publication of the Morgan Stanley report, Karen Hunter, senior vice president of Elsevier, had written a paper about going e-only that included the perspective of both librarians and publishers. Hunter attributed the increase in e-only subscriptions to market forces—patrons and authors desiring electronic versions, and libraries seeking to serve patrons while needing to reap savings from publishers, who offered an e-only option at a lower cost than print or print plus online choices. Hunter questioned whether subscription agents had a viable role in an online-only arrangement, where license terms must be negotiated directly with the publisher. In describing the situation where Academic Press based subscription rates on the electronic version and placed the supplemental charge on the print for customers desiring both versions, Hunter was giving an example of flip pricing without using that label. Initially, contracted bundles of titles from a publisher were based on a library's or a consortium's existing print subscription list, with electronic access having an added charge, but Academic Press had flipped the price structure to be the opposite. Hunter saw obstacles to this becoming a prevalent pricing model, such as the above question about the role of the subscription agent and also the significantly higher European value-added tax for the electronic compared to the paper version of a journal. Hunter also noted archiving as a concern that prohibited some libraries from fully embracing e-only subscriptions. (Archiving is discussed later in this paper.) Van Orsdel and Born documented that OhioLINK became the catalyst for the spread of flip pricing, that the model lowered income for subscription agents due to print subscription pricing at as little as ten percent of list price, and that publishers working directly with libraries for the e-journal subscriptions also lowered the agents' income. Van Orsdel and Born suggested that flip pricing was an indication that librarians were ready to make the transition to electronic "with or without an archiving solution." The move toward going e-only with subscriptions rather than paying for both print and electronic formats gained noticeable momentum. Montgomery and King documented the shift from print to electronic subscriptions at Drexel University over six years: 1,710 print and 200 electronic subscriptions in 1998, and 370 print and 8,600 electronic in 2002. They considered an understudied impact of going e-only, "the changes in the library's operational costs associated with shifts in staffing, resources, materials, space and equipment." The results of the case study "suggest that, when all costs are considered, electronic journals are more cost effective on a per use basis"—however, Montgomery and King cautioned that because of "methodological difficulties with the data available to make the analyses, this study should be viewed as a single first step to address an issue of critical importance to academic libraries." Cox built upon the work at Drexel when he juxtaposed the operational cost analysis information from the Montgomery and King paper with information he obtained from two publishers (Emerald and the Institute of Physics Publishing) to form a preliminary conclusion that greater cost-savings were gained with e-journals than print. Cox indicated his tentative conclusions were based upon admittedly broad assumptions, when he used data drawn from just two publishers and decided upon "a compromise view that fifty percent of the subscription revenue should be attributed to the electronic version." Differences in data collection, such as print reshelving counts versus electronic use statistics and definitions (for example, the term "use" itself), presented problems for Cox's analysis as well, but he hoped to stimulate further study based upon standards. In summary, from 2000 to 2003 the price increase trend for journals continued, fueled in part by publisher mergers, and librarians combated it with the economies found in bundled packages and consortial subscriptions. In another effort to control costs, academic groups created competing journals at a lower subscription price than similar commercial titles. Librarians began to shift toward electronic-only subscriptions to save money in spite of embargoes that deterred them from relying upon aggregated databases alone. Even though a shift was beginning, after analyzing the cost of journal publication and distribution in the electronic arena and considering the impact of such initiatives as SPARC, Quandt affirmed in 2003, that the "paper journals may well become less important over time," but "the predicted demise of the paper journal and, even more so, of commercial publishers, is vastly exaggerated," and "it is unlikely that the increasing dominance of electronic publications will ease the economic plight of libraries in the short run." Seri&ls Management When high costs necessitated cancellation decisions, usage studies often served as a collection management tool in making choices. The literature revealed various models for these studies, such as counts, attempts to define value, cost analyses, behavioral studies, and combinations of methods in order to extrapolate meaning or make projections. For example, Enssle and Wilde described collecting and using statistics from multiple sources, such as interlibrary loan, reshelving counts, Journal Citation Reports from the Institute for Scientific Information (ISI), and vendor-supplied e-journal usage reports to make cancellation decisions. As another example, Galbraith explained how low use and cost-per-use of more than $100 placed journals on a cancellation list each year, but stated that electronic collections had to be analyzed as special cases. Other studies reviewed later in this paper explored new perspectives, formulae, and standards for analyzing use. As collection manag-
Librarians began to develop new techniques of analysis tailored to e-journals that would complement or build upon traditional methods. Library workers in technical services experienced significant changes in workflow due to e-journals. They needed new skills and tools to license and track subscriptions. Librarians and staff in technical services also provided new access services that complemented or enhanced the online catalog's role in leading patrons to content. New companies arose to provide assistance with these new access services. Journal management faced challenges because of corporate mergers and the demise of two integrated library systems and a major subscription agent. This author selected research papers and case studies that have useful foundations for future application or were not so location-specific that they precluded replication elsewhere.

Librarians employed usage studies for cancellation as well as for collection building or adjusting. Talja and Maula conducted an exploratory qualitative study with the goal of "contributing to the development of a domain [discipline] analytic model for explaining e-journal use." The authors' study confirmed "that electronic journal services were more used by those using directed search as the only or dominant method of information retrieval." Article-oriented research was also a strong predictor of e-journal use in this study. Talja and Maula found very little browsing of print journals in the library by the scholars in the fields of nursing and ecological environmental science; in contrast, they found that scholars in history and literature and cultural studies were more book-oriented and browsed for resources.

Davis and Leah examined patterns of individual use, identifying university departments by Internet Protocol (IP) addresses and examining downloads per IP (with IP equated to user). They noted that most users downloaded from a small number of titles. In this study, when Davis and Leah analyzed "American Chemical Society electronic journal downloads at Cornell University by individual IP addresses," they found "a very strong relationship between the number of article downloads and the number of users, implying that a user-population can be estimated by just knowing the total use of a journal." Two mathematical discoveries of particular note were recorded in this paper. "Each user (IP) can be represented by approximately 11 ± 3.5 downloads. This prediction method may be useful for estimating user populations of other publishers' journals when only total number of downloads are provided," and "The quadratic relationship between the number of journals consulted and number of articles downloaded per user suggests that some power law (specifically an inverse square law) may be in effect . . . ." The authors believed user behavior to be a critical element in properly interpreting numerical data.

Gathering usage statistics electronically enabled computer manipulation, which provided greater opportunity for analyzing the numbers in meaningful, contextual ways. In 2003, Bollen, Vemulapalli, and Xu, of the computer science department at Old Dominion University, published a paper with Luce of the Los Alamos National Laboratory (LANL) Research Library describing an automated method of computer log analysis in which they which examined relationships of article downloads "much in the same manner Google's PageRank evaluates the impact of web pages for a given subject on the basis of its context of hyperlinks to other pages." The log analysis for the LANL Research Library created a library-specific, ranked journal list that was compared to the citation impact factor (IF) from ISI, which represented a larger research community. A marked difference in the rankings of titles between the two lists demonstrated that the method "successfully identified a planned and deliberate research project . . . . that caused the local impact of journals to deviate strongly from the ISI IF over a period of three years." The authors recognized some issues that could affect the validity of their data, due primarily to differences in calculating citation impact factor and download data, but noted a lack of alternatives to using impact factor for the broader measurement. Bollen and his colleagues proposed that a representative sample of download logs from different institutions could be aggregated to form a generalized basis of comparison to a specific institution. The authors also suggested that financial constraints increased the importance of tools enabling librarians to make community-specific content decisions, and suggested that future research could lead to an ability to "detect not only past research trends, but also to extrapolate . . . . to the future so that DL [digital library] evaluation can proactively indicate shifts and trends in the interests of user communities."

Through use statistics, Hahn and Faulkner found a way to include the interests of their users in analyzing the value of potential new subscriptions. The authors determined average cost per access, average cost per article, and content-adjusted usage (proportion of total articles used out of total offered). The authors then utilized the cost per article for potential new subscriptions along with the known usage measurements for peer subscriptions in order to set evaluative benchmarks for the potential new subscriptions. Hahn and Faulkner emphasized statistics about the title or collection, such as the amount of content available, as another context needed for e-journal usage statistics to have meaning. As Hahn and Faulkner noted, this need was previously recorded in Judy Luther's White Paper on E-journal Usage Statistics for the Council on Library and Information Resources. Luther's paper covered this point of context as part of a broad range of needs and concerns from publishers and librarians, such as standard definitions and presentation of data.

Zhang gave a succinct historical overview of measurement developments from the mid-nineties through the 2003
publication of her article, “Measurement and Assessment of Networked Resources and Services in Academic Libraries.” The article explained the difficulties of defining standard measurement terms, particularly when applied to counting e-journal subscriptions based on the various ways librarians may track them in an integrated library system (ILS).64 Zhang discussed statistics from the perspective of preparing annual statistics at her library, referencing the annual questionnaires of ARL and explaining an ARL project called E-Metrics, which sought in part to standardize use statistics from suppliers of e-journals.

While E-Metrics was an initiative based in the United States, Project COUNTER (Counting Online Usage of Networked Resources) was “an international initiative designed to serve librarians, publishers and intermediaries by facilitating the recording and exchange of online usage statistics,” and “has its genesis in the UK, with the PALS (Publisher and Librarian Solutions) group formed by JISC, ALPSP and The Publishers Association.”65 The variables considered in the first release of the guidelines, or “Code of Practice,” included “the data elements to be measured[s]; definitions of these data elements; usage report content, format, frequency and methods of delivery; and protocols for combining usage reports from direct use and from use via intermediaries.”66 Project COUNTER showed promise but was not a panacea at this stage, and Molyneux pointed out three positive aspects of the project: it was limited to a reasonable number of variables as a starting point, it would “monitor how the data are collected and tweak definitions as necessary,” and it had received feedback from the field.67 On the other hand, Molyneux professed skepticism regarding vendors openly sharing statistics on their products’ usage, wondered if the execution of the plan would live up to the concept and be speedy enough, and hoped that another phase of COUNTER would address concerns he presented. Molyneux emphasized the importance of being able “to retrieve data on institutions by type (public, academic), by geographic area (country, state or province, electoral district), size (by budgets or collections) and other such variables,” which he labeled as demographic data.68 Finally, Molyneux pointed out the need for “a general, flexible, and adaptable data exchange format” such as XML (Extensible Markup Language for automated document interpretation), making it possible for users of the statistics to work with them without needing to massage the data.69

In addition to continuing to employ usage studies, librarians demonstrated continued interest in core title lists as a collection management tool. In a series of papers first published separately in The Serials Librarian and then cumulated into Journals of the Century, Stankus arranged for experts from several disciplines to write about the “most important, enduring, or influential journals” of the twentieth century.70 Building on earlier work with Bensman, Wilder illustrated a new measure to aid in producing core title lists for scientific and technical journals. He wrote:

> The method requires the creation of a new measure of value called the Estimated Annual Citation Rate (EACR), which is derived from the Journal Citation Reports’ total citation variable. EACR allows researchers to compare the relative value of ST [science and technology] journals, and because it is an annual estimate of citations, it can be compared directly to subscription price to produce a measure of cost-effectiveness.71

Wilder also calculated the cost per EACR and concluded that “when ST journals are properly grouped according to subject, value is highly concentrated among a small number of titles” and that “the high value titles are many times more cost effective than the remaining titles.”72

While collection management librarians improved their tools, technical services librarians grappled with changing processes and heavier work loads. At the start of the millennium, Tuttle’s paper gave perspective to the management of serials in technical services through a progression from the paper-based tracking of orders and receipt of periodical issues in the 1970s to the use of the ILS and the arrival of e-journals in the 1990s.73 Serials management was not easy then, and, as the volume of e-journals rapidly grew, technical services librarians had difficulty tracking what they had purchased from which publisher or aggregator. Four conditions contributed to the problems. First, existing expertise and staffing were insufficient for the volume of work with licensing, adding and subtracting titles as they changed publisher or distributor, correcting broken links as Uniform Resource Locators (URLs) changed, and troubleshooting denial of access. Second, integrated library systems were not designed to record the special attributes of e-journals. Third, mergers both in publishing and in subscription agents added to the complexity in tracking subscriptions. Fourth, e-journals were often acquired by libraries through direct arrangements with publishers, eliminating the subscription agent, sometimes because the publisher refused to permit the use of the agent.

Concerns in libraries about adequate staffing to acquire and maintain electronic resources got little coverage in the literature between 2000 and 2003, but results of three surveys about staffing for electronic resources were published. In 2001, Gardner’s survey results, which covered a range of needs (from organizational structure to training) at ARL institutions, indicated that “88 percent of the respondents believed that e-journals require a greater number of professionals to be involved,” while “thirty-eight percent of responding libraries stated that no new positions had been created to handle e-journals over the previous two years.”74
In 2002, Duranceau and Hepfer collected data from fifteen institutions and stated that "the survey's bottom line is that in academic libraries today, more staff is needed to support e-collections which are growing rapidly in size and significance." Also in 2002, Boydston and Lyesen's paper focused on staffing for cataloging, reporting that "approximately one-third of the libraries reported an increase in MLS staff since beginning the cataloging of electronic resources and almost one-half reported an increase in support staff." Two other papers discussed staffing changes in technical services relative to e-journals. Anderson and Zink explained that the library staff at University of Nevada, Reno, gave up checking in and binding most print serials to spend that time in providing access to e-journals after finding that print journals "get very little use—about .5 reshelvings per issue." In late 2003, Zhang charted differences in ordering and receiving workflow between print and electronic versions, fully illustrating the additional work and then discussing the need to hire a librarian specifically to manage the work with electronic resources. Reporting on a symposium at the 2003 ALA Midwinter Meeting in Philadelphia, Davis noted, "While many libraries are reducing the number of technical services staff, the workflow to support electronic resources is complex, complicated, and costly. [Dan] Tonkery admitted that neither library nor subscription agent nor publisher is fully prepared to manage effectively the new e-resource environment." Licensing for e-resources required special expertise. Because few staff had that expertise, librarians tried new ways to complete the work in a timely manner. Wolverton reported (from a panel presentation at Mississippi State University in 2001) that librarians were interested in learning more about license negotiation points, such as the definition of authorized users, state of jurisdiction, fair use, interlibrary loan, indemnity, and downtime, and were also investigating the potential ramifications of the Uniform Computer Information Transactions Act (UCITA). According to presenter Meraz, "Existing views of First Amendment rights, intellectual property, copyright, fair use, first sale, and privacy could be substantially altered by the passage of UCITA." Wolverton also reported that EBSCO offered a new service to assist libraries in completing a license agreement, presenting the license to the publisher and ensuring finalization in addition to assisting with IP address registration. Keeping up with the volume of licensing had become a problem for some librarians. In 2003, Duranceau reported success with an experiment to send a standard license to publishers, eliminating a backlog and utilizing more staff time rather than having one librarian as a bottleneck: "Ten out of 17 publishers (59 percent) who were sent the MIT license accepted it in some form, either with no changes or few changes." As librarians licensed more e-journals, they looked for a vehicle to track titles and make them accessible. The tool needed the capability to keep pace with the volatility of the titles and URLs with less human intervention. This need gave rise to companies, such as Serials Solutions and TDNet, whose main product was both a service and a system to manage changes in e-journal title sources and their URLs. Dynamic generation of an alphabetized title list of a library's electronic holdings, frequently called an "A to Z list," formed part of the service offered by these companies. McCracken and Markwith, of Serials Solutions and TDNet respectively, wrote papers for a joint presentation at the 2002 North American Serials Interest Group (NASIG) Conference, and both mentioned economies of scale as a primary benefit of using their companies to provide e-journal access to library patrons. Metcalf provided a description of a homegrown product of similar nature in "An Open Source Solution to Managing Electronic Journal Links with Database-Generated Web Pages." McCracken of Serials Solutions described a newer service, one that provided subject access by supplying bibliographic records for librarians to load into the online library catalog as well as including an updating service for the URL's and tracking title changes in aggregated databases. These tools used by technical services provided a navigational service with linking for patrons.

Librarians also began to learn about the technologies involved in deep linking or reference linking—the ability to access a piece of information, such as a journal article, from a citation or other bibliographic data by means of a hyperlink. In 2001, Deeken reported on a presentation by Inger, who explained the benefits of a Digital Object Identifier (DOI), a unique identifier created by a standardized method, resulting in more stability than a URL. Once DOI proved useful, services were built upon its foundation. For example, publishers were able to link to each other's content with CrossRef, an organization that served as a "switchboard" by providing "a method for collecting standardized metadata" and "for looking up DOIs using metadata" (metadata being the bibliographic data for the content referenced).

Needleman explained a new linking standard that underpinned a commercially available navigation service: "OpenURL defines an abstract name for an Internet resource and assumes some resolution mechanism to resolve that abstract name to a current location at which the resource can be found." The resolution system developed with the OpenURL standard, called SFX (licensed by The Ex Libris Group), provided for "context-sensitive" linking that solved the "appropriate copy problem." In other words, the system permitted librarians to input the data for locally held subscriptions, so that the link selectively resolved or led to a resource that the patron was entitled to access as opposed to resources containing the same content but to which the library did not subscribe. Using the system's options, librarians could provide alternatives for titles not available...
institutions began to manage a patron's access to e-journal in a visually familiar textual style, but some publishers and systems were not designed to track e-journals, many libraries to cope with the fact that most extant integrated library best practices, promoting the standards, and engaging databases. Chang's overview of ERMI explained the primary management module designed to work with INNOPAC or stand in 2003, Innovative launched an electronic resource management (ERMI) of the Digital Library Federation (DLF) attempted to provide some standardization for license administration databases. Chang's overview of ERMI explained the primary goal of developing metadata schemata for license terms and the additional goals of "developing workflow, identifying best practices, promoting the standards, and engaging library vendors to implement this system."96

While implementing or building independent tools to cope with the fact that most extant integrated library systems were not designed to track e-journals, many librarians also were facing systems migration, mainly due to two vendor actions: NOTIS was no longer being developed by the newest owner, epixtech, and Sirsi had bought DRA. Other libraries moved to an integrated system after having used separate systems for public and technical services. Migrating serials data presented a challenge. Alan described the careful planning required for such a migration, and how it was handled at Penn State in 2002.97 Sill also described a system implementation in depth, emphasizing that migration necessitated changes to workflow and highlighting the need for interconnectivity between groups of people affected by the migration and integration between the ILS and other systems, such as a separate binding system.98 In an interesting twist that engendered some concern in libraries, Elsevier bought an ILS vendor, Endeavor. Eberhart quoted Richard Johnson, enterprise director for SPARC, as saying, "The long-term issue is how the hardwiring of content into infrastructure will affect the control that libraries have over providing information to their users. The short-term issue is one of fair competition."99

Adding to the concerns of librarians regarding fair competition and staffing needs, subscription agent mergers and a bankruptcy took place. Baseline reported on a panel presentation by librarian Gammon, publisher Cox, and subscription agent representative Tonkery that noted the increased volume of labor for both libraries and subscriptions agents resulting from mergers.100 Mergers caused unanticipated additional work for library staff members, who reviewed multiple title lists for accuracy as a result of system changes when two companies merged into one. Library staff went through this process with SwetsBlackwell (so named as the result of an earlier merger, but renamed Swets again by late 2003), which bought W. H. Everett & Son Ltd., "the world's oldest independent bookseller and subscription agent."101 SwetsBlackwell had previously taken the standing order business of Martinus Nijhoff. Mergers were not the only cause of the additional labor for library serials staff. The unexpected bankruptcy of RoweCom, the subscription agent formerly known as Faxon, left many publishers unpaid for library subscriptions even though the libraries had prepaid the subscription agent. To resolve the problem, librarians worked with publishers and EBSCO, which salvaged RoweCom's business. That situation taught many librarians to watch the financial health of companies to which as much as millions of dollars are sent in advance of receiving goods. Stankus provided a history of RoweCom and its parent company, divine, with an analysis of the situation in his column in Technicalities.102 Little coverage of these events and their effects appeared in the literature.

From 2000 to 2003, both collection management and technical services librarians developed tools to address new needs brought by the growth of e-journal subscriptions. Collection management librarians took advantage of use
statistics gathered by computer to move beyond counts and cost-per-use to form bases for more contextual comparative measurements, such as local and national community use and content-adjusted usage. Librarians needed standardized measurements to compare between resources, and COUNTER provided a baseline, although gaps remained, such as inclusion of demographic data and a technological standard to reduce the need to massage data before using it. Benchmarking with core title lists still proved to be an important measure, but the Estimated Annual Citation Rate introduced a new methodology. These updated tools focused on management of limited resources to target patron needs more closely. Librarians in technical services worked in homegrown databases, participated in developing standards, and adopted commercial services as they became available in order to track subscribed titles and license terms and meet the access and navigation needs of patrons. While developing new management tools, librarians and staff in technical services coped with extra work caused by changes in integrated library systems and subscription agents.

Archiving

During the years 2000 through 2003, archiving grew in importance, but had the appearance of becoming a lesser concern toward the end of 2003, as some libraries, due to budget or physical space pressures or both, went e-only without proven archiving practices for electronic materials. The literature contained ideas and discussions that illustrated the difficulty of archiving electronic materials. Contrast and comparison to familiar practices with print formed a starting point for examining issues, which exposed a struggle in defining who would ideally keep electronic archives, and how and where such archives would be kept. Remote storage played an archival role, though it was used primarily to solve space shortages. Some libraries relied upon a shared collection of print journals as a means of archiving. Cases of missing online content further complicated the archiving issues. The lighter coverage of archiving in the literature reflected the early stages of addressing the problems.

Guzu recorded the thoughts expressed by presenter Drewes at the 2000 NASIG Conference. Drewes raised the possibilities and questions relative to archiving both print and electronic journals at the time: whether or not to bind, the impact of ARL statistical counts of bound volumes on decision-making, publisher focus on profits rendering them imperfect as archivists, the possibility of consortia serving as an archiving entity rather than individual libraries, the space savings by going e-only, the ability to provide interlibrary loans, differences between versions, the title of record usually being print, and the impermanence of CD-ROMs as archival copies. Drewes recommended that librarians retain paper issues of journals without binding and also lobby organizations collecting statistics to include e-journals in measurements. Boyce described an environment with a focus on maintaining access to information, contrasting old and new modes of thinking about the functionality of publications, libraries, and archiving, and he also described the new concept of preservation as an automated system for refreshment of data residing in multiple repositories:

In the modern world of electronic information, the medium of choice is a redundant array of hard disks (RAID). Because of the automatic testing and backup inherent in the RAID system, deterioration of the storage medium is not a factor any more. The automated, active system keeps the material refreshed and readable at a very low cost, and the information is available within milliseconds. This is a far cry from the days of off-line tape storage, where accessing and refreshing were expensive, manual chores and there was a delay of hours or days to even get access. Today the data are rewritten many times, being kept fresh, readable, and intact by the automated systems.

Storage facilities addressed space shortages in libraries, but also became de facto archives of print journals, particularly in cases where electronic access was available. JSTOR (Journal Storage: The Scholarly Journal Archive), a large digitized collection of the back files of selected print journals, served as a primary model, with an archive collection of print on behalf of many libraries. Young explained, "Originally begun with a grant from the Mellon Foundation, JSTOR was seen as a partial solution to the problems of diminishing library stack space for bound volumes, the increasing fragility of older volumes, and the difficulties for publishers inherent in maintaining a printed archive." Librarians who were ready to rely upon use of the electronic version of journals were not always ready to give up the locally owned print volumes to rely upon another archival copy. At the University of Nebraska-Lincoln, Tyler and Zillig recommended moving the bound volumes that duplicated the material in JSTOR to remote storage. Block’s essay on the history of remote storage, beginning with antiquity, gave a timeline listing notable facilities built in modern times, including the Harvard Depository, which is not a shared facility, but one that pioneered in construction approach, and the two California regional facilities, which contain the holdings of multiple University of California libraries. Weeks and Chepusiak reviewed the Harvard Model and recorded that more libraries collaborated in joint storage facilities, including a number of libraries in Minnesota, with a statewide facility, and also Princeton University, Columbia University, and the New York Public Library joining together to form
the Research Collections and Preservation Consortium. As those facilities were in beginning stages, Hill, Madarash-Hill, and Hayes recorded that the University of Akron Science and Technology Library determined that storage away from the library resulted in a negative impact on the use of serials, with a post-move decrease of 70.58 percent in use of the oldest volumes. The literature suggests that few such shared storage archives existed by the end of 2003.

Electronic archiving was difficult to define and more complex than print archiving. In 2000, Hunter of Elsevier wrote about options surrounding the usual questions of who would do the archiving, where and how many copies would be kept, what kind of access would be needed, and how much archiving would cost. Hunter wrote that there was "a presumption [among librarians and publishers] that for online journals, migration will be the methodology of choice." Baudoin took the stand that preservation of e-journals must be independent of platform and preserve the dynamism as well. She cited examples in both the sciences and humanities. Flecker provided an overview of the initiatives to tackle the archiving problems in 2001. He described LOCKSS (Lots of Copies Keeps Stuff Safe), one of several archiving projects funded by Mellon grants, which is "is intended to automatically, and with little cost or overhead, support the large-scale replication of e-journal content." Flecker stated that minimizing costs would be a primary consideration in the future of archiving. Hughes' paper in 2002, building upon the papers of Hunter and Flecker, provided a recap and update of the archiving initiatives and issues, suggesting that having a third party (other than publishers or librarians) was the preferred archiving concept at the time. In a paper listing a few of the same initiatives described by Flecker and Hughes, Thomas noted, "One of the chief reasons cited by librarians for retaining paper is the inability of the publisher to guarantee the longevity of documents."

In addition to assured longevity, completeness and accuracy issues needed to be resolved. One reason for loss of online content became evident as early as 2000, in the wake of the 1999 Tasini versus The New York Times Supreme Court case decision, which stated that specific electronic as well as first-publication rights are necessary for articles written by freelance authors in order to publish them electronically. Garman stated the concern that publishers and aggregators would "have to remove thousands, if not millions, of full-text articles to be in compliance with authors' rights" if terms could not be negotiated for the electronic version. By 2001, Bates reported that content providers had indeed removed some articles from sources such as newspapers in Dialog. In 2002, Chen published a paper about missing content in aggregated databases due not only to the Tasini case, but also to embargoes and publishers choosing not to participate in aggregations. Chen emphasized the loss of 100,000 articles from the New York Times and the full or majority loss of online text for nineteen newspapers from several major cities in the United States. Chen found a wide range of embargoed titles, from "less than 5% to over 40%, depending on products and aggregators" and noted that the aggregators "seemed" to include citations to embargoed material only after the embargo period had passed. In the print version of journals, publishers could only print notices of retraction or errors once an article had been publicly released; however, they had the ability to remove the improper articles entirely in the electronic version, changing the historical record. In 2003, an editorial by Plutchak recommended that publishers' retraction and correction policies balance between protecting "the integrity of the scientific record" and a publisher's "legal liability," citing Elsevier's progressive actions in this endeavor as an illustration.

From 2000 to 2003, archiving questions included both the print and electronic versions of journals. Librarians archived print volumes in storage facilities, with or without having electronic access as an alternative, due to space shortages. The paper by Hill, Madarash-Hill, and Hayes documented the decline in use of stored materials and how some librarians made efforts to send print volumes of titles also available electronically, such as those in JSTOR, to storage facilities. Universities constructed more shared storage facilities. Librarians and publishers struggled with electronic archiving concepts, discussing questions of who, where, and how, as the dynamism of the format complicated issues. Projects such as LOCKSS tested potential solutions, but missing online content posed more difficulties.

Conclusion

The papers reviewed illustrated significant changes driven primarily by the growth of electronic resources in the first few years of the new millennium in the serials industry. Electronic journals became a focal point as both a source of problems for archiving and management and as a solution to patron desires and space shortages. Librarians first hailed e-journal bundles as a cost-saving model of scholarly communication and later disparaged them as a model for locking up the materials budget. Nonprofit initiatives such as SPARC promoted cheaper access to serials. Open access made information freely available to readers, having been paid for by the authors. Mergers led to higher costs in both expenditures and increased labor to manage serials. Research highlighted staffing shortages as librarians and staff, who acquire and manage e-journals, required new skills. Librarians and vendors developed new standards and delivered new linking and navigation
services to patrons, and librarians applied features of the services in tackling title and license term management problems. The literature identified problems and expectations with who should archive electronic materials and how. Missing online content complicated the archiving problems, but librarians began testing potential solutions such as LOCKSS.

Papers highly relative to collection management topics, such as costs and usage studies, were plentiful, but finding peer-reviewed literature related to management needs in technical services proved more difficult. Current events that had significant impact on technical services for serials, such as corporate mergers and their effects, were not well-documented in peer-reviewed literature. This author found no papers on the effects of consortial purchasing on librarians' use of the subscription agent and whether consortia usurped the agent's role to any degree. How would librarians fare without subscription agents for e-only subscriptions? Research for a solution to electronic archiving was only beginning in earnest as print subscriptions were dropping, and it was not surprising to find relatively few papers on the topic. Considering the rapid pace of changes with the advent of e-journals, much of the upheaval was captured in the literature, and perhaps the next review of serials literature will contain research showing how librarians surmounted obstacles regarding the cost, management, and archiving of electronic journals.

References

5. Ibid., 154.
12. Ibid.
20. Ibid.
21. Ibid., 235-36.
22. Ibid., 236.


36. Ibid., 243-60.


41. Ibid.

42. Ibid.

43. Ibid., 5.


46. Ibid., 51


48. Ibid.

49. Ibid.


55. Ibid., 685.


57. Ibid.,1062.

58. Ibid.,1067.


60. Ibid.

61. Ibid.


68. Ibid., 93-94.

69. Ibid., 94.


72. Ibid., 96.


74. Susan Gardner, “The Impact of Electronic Journals on Library Staff at ARL Member Institutions: A Survey and


81. Ibid., 155.

82. Ibid.


91. Ibid., 75–76.


113. Ibid.


117. Mary Ellen Bates, "'Houston, Do You Copy?'" *EContent* 24, no. 7 (Sept. 2001): 64.


119. Ibid., 29.


121. Hill, Madarash-Hill, and Hayes, "Remote Storage of Serials."