Review Essay

A Review of Information Science and Computer Science Literature to Support Archival Work with Electronic Records

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Abstract: Archivists share with information and computer scientists many concerns relating to the long-term accessibility of information created and maintained with modern technology. However, the literature of information and computer scientists is largely unused by archivists working with electronic records. This literature can be used effectively if electronic records archivists approach it with a clear understanding of their own needs and a sense of the purpose of the materials being used. This essay reviews a selection of the vast literature of information and computer science. The essay makes recommendations for how these materials may support archival work in managing and preserving electronic records and also describes some of the bibliographic tools needed to access these useful resources.

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ARCHIVISTS DO NOT HAVE A MONOPOLY on the issues associated with the preservation and management of electronic records.[1] The archival profession brings unique concerns to bear on these issues—particularly the need to preserve the contextual information surrounding records and the long-term preservation of the recorded information itself. However, archivists definitely are not alone in addressing such issues as migrating records from one hardware and software environment to another, documenting the meaning of records, providing adequate descriptions of records to allow users to locate them, analyzing the durability of storage media, and making records usable and understandable outside of their native environments. The information science and computer science fields are among the most important areas from which archivists can draw expertise and experience for building effective electronic records programs. Research results and work in progress in these two fields can augment archival efforts in working with electronic records by increasing archivists' understanding of the purposes and theories of information systems, the ways in which information systems are used, and the technology that supports the modern information environment.

The CART electronic records and techniques curriculum underscores the value of an interdisciplinary approach to electronic records. The curriculum adapts useful tools and techniques from other disciplines to the goals of archival work. Even though archivists have not extensively used literature beyond "traditional" archival sources to assess and develop their programs for managing and preserving electronic records, the archival profession need not begin from the ground up. Other disciplines can contribute to and support archivists' efforts, as demonstrated by the abundant resources found in nonarchival literature.

Glen McAninch and Marion Matters provide a sense of the broad and diverse nature of these resources in the lengthy directory of periodicals in chapter five of *Automated Records and Techniques in Archives: A Resource Directory.*[2] The abundance of available information can inundate any user without guidance in selecting literature that is understandable, easy to locate, well indexed, and germane to archival work. An important component of the CART curriculum is the clear statement of learning objectives, which emphasizes the specific goals for teaching about electronic records and techniques in the context of archival work. Archivists who use literature beyond the traditional archival resources must approach it with the same clarity of purpose, or risk being overwhelmed by the amount of information, much of which is technical.

This essay reviews the literature from the information science and computer science fields as materials from which archivists can borrow, adopt, and learn. The materials were chosen for their value in supporting the management and preservation of electronic records. However, many of these resources can and should also be used in developing automated techniques for access to archival records. In fact the goals of preservation and access largely converge when dealing with information in electronic form. Information systems are becoming more complex and user demands for information access are growing to take advantage of new technology. This changing environment requires archivists to use the self-descriptive capabilities of information systems and seek more sophisti-

[1]An excellent review of much of the best current literature on electronic records written by archivists is Terry Cook, "Easy to Byte, Harder to Chew: The Second Generation of Electronic Records Archives," *Archivaria* 33 (Winter 1991–92): 202–216.

[2]Marion Matters, ed., *Automated Records and Techniques in Archives: A Resource Directory* (Chicago: Society of American Archivists, 1990).

cated tools for locating and retrieving the electronic information they preserve.

The problem with the rich literature from the library, information science, and computer science fields is overabundance. How can archivists find appropriate and useful material from the thousands of books and articles published each year on computers and information science? What criteria should we use to judge their relevance and quality? How do we find the works that will benefit our efforts to develop effective approaches to the management of electronic records?

With these concerns in mind, I selected materials based on their availability in most research libraries and because they contain essays, papers, articles, and reports that provide useful and valuable information on topics that support archival work with electronic records. Specifically, I identified literature that discusses the impact of automation on organizational documentation and continuing access to electronic records. In addition, these materials are indexed sufficiently to be accessible for regular reference. Other resources also meet these requirements, but this essay covers a manageable body of literature as a place to start.

The publications presented here range from general introductions to specialized journals on specific technologies. These materials will be useful to a broad range of archivists working with electronic records. Much of the information science literature will be of most benefit to archivists designing automated applications, analyzing active systems, and developing electronic records programs. The more specialized and technical literature from the computer science and electrical engineering fields will be useful primarily to a few archivists who are responsible for specialized aspects of electronic records work.

The following entries are divided into five categories. The first section identifies and describes general works and periodicals that introduce information technologies, describe the environment in which electronic records are created, and explain trends in automation. The second section, Library and Information Science, covers a domain of literature distinguished by research into organizational communication, information access methods and techniques, and control of and access to electronic data. The third section discusses the literature associated with the computer science and electrical engineering fields. This section is more lengthy and is presented in more depth than the previous sections because it covers literature that archivists addressing electronic records have used the least. This domain of literature focuses on the technology that supports electronic information systems. Many of the journals and texts are specific to a particular technology area, such as networks and networking, but the literature also supports some of the theoretical aspects of information systems, analyzing what information systems do, how people and data interact with technology, and why technology works in a particular way. The section describes the subjects covered by these materials and provides some caveats about the technical level of the materials. The fourth section, Other Disciplines, is a brief overview of literature about optical imaging and geographic information systems (GISs). Imaging and GISs are only the latest in a series of new technologies that challenge existing archival techniques and methods. The section illustrates the extent of literature in specific technological areas and describes some useful resources for learning about these technologies. The concluding section is an overview of the key indexes and abstract journals that are absolutely necessary to access and use this large body of literature effectively.

General Works and Periodicals

There is an abundance of general computer magazines and monographs that are

introductions to information technology, as evidenced by the computer books section in any chain bookstore. From this abundance, a few monographs and magazines stand out as informative, easy to read, and generally very useful. William Saffady's *Introduction to Automation for Librarians* is one of the best general introductions to information technology.[3] Written as a textbook for library education, Saffady's monograph is accessible and comprehensive. Part 1 presents the basics of automation: computer hardware and software, data processing concepts, and automated office systems and related technologies. It is the most valuable section for archivists who need a basic orientation to information technology. Part 2 deals exclusively with automated applications in libraries. Saffady's clear writing style is punctuated with examples from existing applications and easy-to-understand diagrams and graphs. Each chapter ends with an extensive reading list. This is a good starting point for the archivist who knows very little about information technology.

High-Tech Society by Tom Forester is another excellent introduction to information technology. In it, Forester analyzes the role and impact of technology on society. He goes into more detail and analysis of technologies than does Saffady, providing an important contextual link between technology and the people and organizations that create and use it. The book also provides a historical perspective on technology.[4] Another interesting historical work that is a useful introduction to information technology is *A History of the Personal Workstation,* a collection of essays, papers, and proceedings from a January 1986 conference of many of the key figures in the development of modern end-user computer interfaces. Although the book focuses on the history of a narrowly defined but important technology, archivists will find some of the chapters useful for understanding early office automation systems and the concepts that govern the development of current end-user computer systems.[5]

The Ellis Horwood books on computers and their applications are a series of well-written monographs on computer hardware, software, and basic data processing concepts. Ellis Horwood, a publishing subsidiary of Simon and Schuster, is based in Great Britain. The series consists of over one hundred titles covering such topics as open-systems interconnection, local area networks, data communications, and systems analysis. This series is a useful and broad resource for archivists who need a more substantive but nontechnical background on technical areas.[6]

Perhaps the most comprehensive, objective, and accessible periodical is *Computer,*[7] the monthly popular magazine of the Institute of Electronics and Electrical Engineers (IEEE) Computer Society. *Computer* describes itself as "an authoritative, easy to read magazine containing tutorial and in-depth topics across the computer field, plus news, conferences, calendar, interviews, and product reviews." Archivists may find this to be the most accessible general-audience publication of the IEEE Computer Society. It is a valuable resource for a basic understanding of trends and activities in the electrical engineering and computer science fields.

[3]William Saffady, *Introduction to Automation for Librarians,* 2nd ed. (Chicago: American Library Association, 1989).

[4]Tom Forester, *High-Tech Society: The Story of the Information Technology Revolution* (Cambridge, Mass: MIT Press, 1987).

[5]Adele Goldberg, ed., *A History of the Personal Workstation* (New York: ACM Press, 1988).

[6]Two examples from this series are John Henshall and Sandy Shaw, *OSI Explained: End-to-End Computer Communication Standards,* 2nd ed. (New York: Ellis Horwood, 1990); and W. Scott Currie, *LANs Explained: A Guide to Local Area Networks* (Chichester, England: Ellis Horwood, 1988).

[7]*Computer* (Long Beach, Calif.: IEEE Computer Society). Bimonthly. ISSN 0018–9162.

There are a lot of popular magazines that are more common than *Computer.* Most general magazines are aimed at the microcomputer and small systems environment, and *Byte* is notable among them.[8] Most issues of the magazine are built around a theme; for example, in June 1992, the feature was a series of essays on "Managing Infoglut." For archivists who are interested in the management and preservation of text files the June 1992 issue offers an in-depth treatment of issues surrounding the creation, preservation, and documentation and authentification of textual data. It is written from multiple perspectives, including those of academics, researchers, and, of course, vendors. Since each issue focuses on a particular theme, *Byte* is particularly valuable because it coalesces a lot of information on a specific topic. Moreover, the essays in this magazine are lengthy, well researched, and informative. If you are going to subscribe to one of the more common computer magazines *Byte* is worth considering.

Another magazine familiar to virtually every personal computer owner is *PC Magazine.*[9] This periodical is, as its name suggests, limited to the IBM/clone personal computer environment. Most articles in *PC Magazine* deal with hardware and applications software trends and issues. *PC Magazine* is a good example of a source for tracking the trends in desktop computing technology. Like most computer magazines for both the IBM personal computer and Macintosh computers, *PC Magazine* does not treat topics in any great depth; rather, it is a forum for introducing and comparing the latest hardware and software products.

There are so many magazines to choose from, but few are ordinarily useful to archivists beyond presenting glimpses of the latest trends in monitors for the IBM personal computer or the latest graphics package for the Mac. The selection of a magazine that will keep you up to date on the latest trends in personal computing or computing in general should be based on understandability, comprehensiveness, depth of treatment of issues, inclusion of information management issues in the context of technology discussions, and lack of bias toward a particular vendor or technology area.

Library and Information Science

One would expect the literature of librarianship and information science to be heavily used by archivists because of the two fields' parallel activities in the areas of reference, indexing systems, and cataloging processes. This is not entirely the case. Archivists frequently consult information science literature to learn about automated information storage and retrieval systems, but they rarely use several excellent journals that could support their work in the area of electronic records management and preservation. This section reviews several information science and library journals and newsletters that archivists may not recognize as valuable sources of information about electronic records issues.

The American Society for Information Science (ASIS) is the foremost professional association for information scientists. The close relationship between information science and communications makes ASIS a likely ally in addressing the larger questions of the impact of automation on organizational documentation.[10] The official journal of ASIS, the *Journal of the American Society for Information Science*

[8]*Byte* (Peterborough, N.H.: McGraw-Hill). Monthly. ISSN 0360–5280.

[9]*PC Magazine* (Boulder, Colo.: Ziff-Davis). Biweekly. ISSN 0888–8507.

[10]Christine L. Borgman and Ronald E. Rice, "The Convergence of Information Science and Communication: A Bibliographic Analysis," *Journal of the American Society for Information Science* 43 (July 1992): 397–411.

(JASIS),[11] is perhaps best known for its papers on bibliometrics, storage and retrieval systems, and indexing methods, but *JASIS* often also contains papers of interest to archivists who are exploring the changing nature of documentation. Examples from recent issues include Mary Culinan and James Bair's analysis of the impact of office automation on communication-related productivity and Michael Cooper's research on the types of use made of a PROFS system by three hundred users.[12] *JASIS* also features literature on information technology, such as the issue dedicated to the development of information technology standards (volume 43, no. 8), to which several archivists contributed. This particular issue is an easy-to-understand and pertinent analysis of the standards-making process as well as of some standards themselves. *JASIS* is an important journal for archivists because of its scholarly orientation, its broad range of topics, and its function as the primary publishing source for the information science community. Archivists who use *JASIS* should remember that it is published for information scientists whose research interests often do not relate to archival issues. Moreover, archivists will need to understand research methods employed by information scientists in order to benefit fully from many of the pertinent essays in *JASIS.*

Six times a year ASIS also publishes the *Bulletin of the American Society for Information Science,* a "news magazine concentrating on issues affecting the information field."[13] The *Bulletin* is limited to brief essays addressing a wide variety of information science issues, making it more accessible than *JASIS* for a nontechnical audience. Recent issues of the *Bulletin* have featured essays on government information policy and its impact on electronic records management and preservation (sponsored by NAGARA), electronic data interchange, and educational programs in the information sciences. The October 1993 issue devoted to electronic records programs is cosponsored by SAA's Electronic Records Roundtable and the ASIS Special Interest Group on Numeric Databases. The *Bulletin* is always worth reviewing for brief articles of value to work with electronic records.

Library Hi-Tech[14] is a good resource for accessible and pertinent literature on technology, standards, and issues related to electronic information. As stated in the Summer 1983 inaugural issue, the journal's three main goals are to serve as a current guide to all available technologies applicable to libraries and information centers, to be the single source reviewing related literature, and to be a major journal of practical articles related to all available and forthcoming technologies. Topics covered since 1989 include the durability of floppy disks, computers and personal privacy, artificial intelligence and knowledge systems, the Z39.50 Search and Retrieve Protocol, and access to electronic texts. Perhaps the best example of the value of *Library Hi-Tech* is the 1990 special issue on Open Systems Interconnection (OSI), which presented one of the best and easiest-to-understand overviews of OSI available.[15]

The International Association for Social

[11]*JASIS (Journal of the American Society for Information Science)* (New York: John Wiley and Sons). Bimonthly. ISSN 0002–8231.

[12]Mary J. Culinan and James H. Bair, "Human Communication Needs and Organizational Productivity: The Potential Impact of Office Automation," *Journal of the American Society for Information Science* 34 (May 1983): 215–21; Michael D. Cooper, "User Skill Acquisition in Office Information Systems," *Journal of the American Society for Information Science* 42 (December 1991): 735–46.

[13]*Bulletin of the American Society for Information Science* (Silver Spring, Md.). Bimonthly. ISSN 0095–4403.

[14]*Library Hi-Tech* (Ann Arbor, Mich.: Pierian Press). Quarterly. ISSN 0737–8831.

[15]Ray Denenberg, ed., *Library Hi-Tech,* Consecutive Issue 32, vol. 8, no. 4.

Science Information Service and Technology's (IASSIST) professional journal *IASSIST Quarterly*[16] contains papers of direct applicability to electronic records archivists. The journal reflects the association's membership of data librarians and data archivists in university settings. Topics in the journal include preservation, data migration, documentation of electronic data, access services for electronic data, and new data structures. The *IASSIST Quarterly* is required reading for any archivist working with electronic records.

Archivists will frequently find the articles in the *Electronic Library*[17] useful and understandable. Despite its title, the *Electronic Library* contains essays that discuss the management and preservation of information in electronic form as well as electronic tools for accessing information. Examples from the journal include Monica Blake's 1989 article on access to and retention and storage of electronic publications; Brian Kahin's investigation of scholarly communication in a networked environment; and a recent essay on approaches to managing documents and textual data.[18] The papers and essays in this journal are brief and limited in scope, but they parallel research under way in archival settings and could contribute to that work.

Computer Science and Electrical Engineering

Archivists may underutilize the literature of library and information science, but they virtually ignore the literature of the computer science and electrical engineering fields. Computer science and electrical engineering literature is intimidating because of its technical nature and orientation toward audiences of computer scientists and engineers. Despite these cautions, there is much in this literature that can support archival work with electronic records if archivists use it judiciously and with a clear understanding of its potential application to their work. The two leading publishing organizations in this field are the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers. Although these organizations represent specialized fields and their publications use technical language that does not translate well to archival functions, archivists should be aware of and willing to use a number resources these organizations produce. Publications that are the least technical and broadest in scope are the most likely to provide useful information to archivists managing and preserving electronic records.

Materials from the computer science and electrical engineering fields are written for a specialized technical audience. Generally, only archivists who work in specialized areas of electronic records management and preservation will find this literature of value to their efforts. Once again, the issue of relevance is critical for benefiting from the literature of these nonarchival professions. It is especially important for archivists to have clear goals for the service they expect from this technical literature.

The Association for Computing Machinery (ACM) is the one of the largest organizations of computing professionals in the world. This organization brings together computing professionals from a wide variety of backgrounds and interests, who, through the ACM and its various constituent groups (generally special interest groups or SIGs), produce extensive and diverse publications. Because of its technical nature and perspective, ACM literature can

[16]*IASSIST Quarterly* (Santa Monica, Calif.). Quarterly. ISSN 0739–1137.

[17]*Electronic Library* (Medford, N.J.: Learned Information). Monthly. ISSN 0264–0473.

[18]Monica Blake, "Archiving of Electronic Publications," *Electronic Library* 7 (December 1989): 376–86; Brian Kahin, "Scholarly Communication in a Networked Environment: Issues of Principal, Policy, and Practice," *Electronic Library* 10 (October 1992): 275–86; G. W. Van Putten and R. Smedinga, "The Possibilities and Limitations of Document Information Systems and Text Management Systems in Organisations," *Electronic Library* 10 (February 1992): 33–39.

be inaccessible for even experienced electronic records archivists, yet there is much to learn from the ACM and its affiliated organizations. Computer professionals and archivists share an interest in such problems as authentication, preservation of context, data migration, and storage and retrieval, but computer scientists have a significantly more technical perspective.

ACM Computing Surveys[19] is a quarterly journal with an extremely broad range of topics, from the design of information systems to data structures to microcomputer operating systems. *Computing Surveys* seeks to provide essays that organize and integrate a body of existing knowledge to inform the broader computer science community. Papers that appear in the journal are written with an understanding that most readers are unfamiliar with the topic, which makes them particularly useful to archivists because they do not presume specialized technical training.

ACM Transactions on Information Systems[20] focuses on broader issues within the context of information system design, implementation, and development. Topics in recent issues have included documentation of information systems, object-oriented applications, intersystem communication, and search and retrieval methodologies. This journal is technical and there is little value in reviewing it regularly. However, it is one of the best resources for developing a greater understanding of the concepts, terminology, and orientation of computer science professionals who design information systems. Archivists will benefit from using this journal to understand how systems create and manipulate information for descriptive and preservation purposes, but they should approach the journal with the goal of increasing their understanding of how information systems professionals approach the same topic.

Office information systems are slowly transforming the ways in which traditional business practices are documented. Archivists must understand these new office systems in order to develop effective strategies for ensuring the adequacy of documentation of many traditional organizational activities. The *ACM SIG OIS Bulletin*[21] is the quarterly publication of the ACM Special Interest Group on Office Information Systems. It is devoted to discussions of both technical and organizational issues on office automation. Essays in the *Bulletin* are well written and generally appropriate to the issues of both information management and technology. The *Bulletin* is a collection of essays on the management, implementation, and operation of office information systems. Examples of recent essays include "Observations on the Implementation and Use of Office Information Systems—A Case Study" and "Office Documents on a Database Kernel—Filing, Retrieval, and Archiving." The latter essay is part of a special issue of proceedings of a 1990 conference on Office Information Systems held in Cambridge, Massachusetts.

The Institute of Electrical and Electronics Engineers (IEEE) is an organization of engineers and technicians which rivals the ACM in the extensiveness of its publications. The major difference between the two organizations is that the IEEE focuses on the engineering and technical aspects of computer science and the ACM focuses on its mathematical and logical aspects. The IEEE's Computer Society is the source of most of the literature of interest to elec-

[19] *ACM Computing Surveys* (New York: Association for Computing Machinery). Quarterly. ISSN 0360–0300.

[20] *ACM Transactions on Information Systems* (New York: Association for Computing Machinery). Quarterly. ISSN 1046–8188.

[21] *SIG OIS Bulletin* (New York: Association for Computing Machinery, Special Interest Group on Office Information Systems). Irregular.

tronic records archivists. The Computer Society publishes seven magazines and five research transactions as well as over one hundred other titles each year.

The IEEE's *Computer Graphics and Applications*[22] magazine is published bimonthly by the IEEE Computer Society. It focuses on imaging, computer modeling, and complex computer graphics. Recently the magazine has focused heavily on medical imaging. As archivists begin to confront the issues involved with managing and preserving multimedia records they will find this magazine especially useful for understanding both the technology and the ways it is used.

Networks and interconnectivity of electronic information systems are having an impact on the nature of documentation and its role within organizations. The *IEEE Network*[23] magazine, published monthly by the IEEE Communications Society, is a useful resource for a deeper understanding of the technical aspects of networks. The articles and essays in this magazine are of limited use to archivists because a majority of them are technical discussions related to interconnectivity. However, archivists will find the New Books section very useful for developing a better understanding of interconnected information systems and the records that they create. The section features abstracts of new literature on networking and interconnectivity from a variety of technical and nontechnical perspectives.

The IEEE Computer Society also publishes *IEEE Software,*[24] a bimonthly magazine written largely for software engineers. Although technical in scope, *IEEE Software* is useful to electronic records archivists who work with software-dependent data. An article in the November 1992 issue focused on porting multimedia applications, for example, and included an annotated list of standards related to data portability. This type of information will be especially useful for technical preservation staff in archives.

The society publishes several research journals, among them the monthly *IEEE Transactions on Software Engineering,*[25] which is broad enough in scope to contain articles that archivists can use. This journal contains scholarly research articles on the electrical engineering aspects of computers. Archivists will find this journal worth monitoring for occasional discussions of data structures, standards making, and trends in computing.

Finding general information on specific technologies or products is often very difficult, and one of the few available resources is the series of information products published by DataPro Information Services.[26] Unlike journal articles, these publications provide a readily accessible, very usable, and objective source of information on information technology. DataPro's printed information products consist of a series of constantly updated product evaluations, management advice, and market research on a wide range of topics, including communications, information systems, office technologies, and document imaging systems. Archivists who need a quick source of readable information on specific technologies, standards, or trends will find the *DataPro Reports* product of great use. The

[22]*Computer Graphics and Applications* (New York: IEEE Computer Society). Bimonthly. ISSN 0272–1716.

[23]*IEEE Network* (New York: IEEE Communications Society). Bimonthly. ISSN 0890–8044.

[24]*IEEE Software* (New York: IEEE Computer Society). Bimonthly. ISSN 0740–7459.

[25]*IEEE Transactions on Software Engineering* (New York: IEEE Computer Society). Monthly. ISSN 0098–5589.

[26]The DataPro Research Corporation, a division of McGraw-Hill, publishes an assortment of reports, product evaluations, and guides to technology, each as a separate title. For information on specific DataPro products, contact the company's sales and customer support unit at 600 Delran Parkway, P.O. Box 1066, Delran, NJ 08075, or via their toll-free phone number 1-800-328-2776.

Reports are just one of the DataPro information services, and they approach topics from a range of perspectives, depending on the type of report. Readers will find overview reports with market analyses, technology overviews, and product comparison columns; product reports that analyze a specific information technology product; and concept reports that analyze and discuss issues, trends, standards, and new technologies. A master index to all of the publications is available to provide access to the entire range of DataPro information products. Most electronic data processing sections in large organizations subscribe to some of the DataPro products as a ready resource for product evaluations. DataPro products are also generally available in larger research libraries.

The National Computer Systems Laboratory of the National Institute of Standards and Technology is a prolific publisher of monographs addressing many aspects of computer science and information management. Publications of the laboratory are indexed in the *Monthly Catalog of U.S. Government Publications* and are available through the U.S. Government Printing Office sales division. These monographs are an excellent resource for both general and more specific information about data processing methods, techniques, and standards; storage technologies; and the role of national standards in managing electronic information systems. Although many of the publications dwell on the mundane aspects of information systems management and federal information processing regulations and requirements, they are very understandable, easily obtained, and inexpensive publications covering a wide range of topics. A sampling of the types of publications that the National Computer Systems Laboratory produces include a *Guide to Data Administration, A Technical Overview of the Information Resource Directory System (IRDS), A Management Guide to the Protection of Information Resources,* and *3480 Type Cartridge: Potential Data Storage Risks and Care and Handling Procedures to Minimize Risks.*[27]

Other Disciplines

Discipline- or technology-specific literature is abundant. Two significant technologies that archivists are currently addressing are digital imaging and geographic information systems (GISs), but the specific technology areas archivists must understand better will change constantly. These two areas are currently at the forefront and their example is instructive for research in other topic areas. Archivists must be willing and able to use the literature of specific disciplines to address new technologies effectively. Ideally, these two examples will not only provide some value for current research in these areas but will also serve as an example of the type of opportunities available in the literature surrounding other specific technologies.

Most archivists who have worked with microfilm are very familiar with the Association for Information and Image Management (AIIM) and its programs. AIIM also works extensively in such nonmicrographic technologies as digital imaging. The association's journal *Inform*[28] is a resource for concise, well-researched, and understandable information on micrographics, digital imaging, computer output to laser disk, and other optical recording technologies. Articles that appear in *Inform* range

[27]Bruce K. Rosen and Margaret K. Law, *A Guide to Data Administration* (Gaithersburg, Md.: National Institutes of Standards and Technology, 1990); Alan Goldfine and Patricia Konig, *A Technical Overview of the Information Resource Directory System* (Gaithersburg, Md.: National Institute of Standards and Technology, 1988); Cheryl Helsig, Marianne Swanson, and Anne Marie Todd, *Management Guide to the Protection of Information Resources* (Gaithersburg, Md.: National Computer Systems Laboratory, 1989).

[28]*Inform* (Silver Spring, Md.: Association for Information and Image Management). Quarterly. ISSN 0892–3876.

from technical discussions of specific recording technologies to higher-level policy and procedural discussions on the role and impact of digital imaging technology. AIIM also publishes over two hundred technical leaflets, standards, guidelines, and monographs dealing with technical, organizational, and policy aspects of imaging technologies.

Archivists interested in imaging and optical recording technology will also find *Document Image Automation,*[29] formerly *Optical Information Systems,*[30] especially useful. This bimonthly journal, published by Meckler, features research articles and case studies of imaging applications. Of particular interest to archivists are articles on standards for imaging and optical recording media, such as Marilyn Courtot's article "Impact of Optical Storage Standards on the Image and Information Industry," which appeared in the March–April 1990 issue.

Geographic Information Systems (GISs) are one of the fastest-growing information technologies that archivists must confront. GISs present opportunities and problems similar to those in database and imaging technology, but they do so within a more well-defined set of application areas. One of the major professional associations working with GISs and the issues that surround them is the Urban and Regional Information Systems Association (URISA), which was officially formed in 1966, although it traces its origins to 1962. URISA has regularly published proceedings of its annual conferences,[31] which contain edited versions of most of the papers presented at the conference. The proceedings of the 1992 conference featured articles on the copyright of data in geographic information systems, the national spatial data transfer standard, and issues associated with multijurisdictional data. In 1990, URISA inaugurated its research journal, the *URISA Journal.*[32] Because of its scholarly nature and the type of papers published in it, this journal is a critical source of information for archivists working with GISs. Recent issues have included research on migration of data from one hardware or software environment to another, managing multijurisdictional data in a GIS, protection of personal information in a GIS, and copyright of a GIS database.

A significantly more technical journal on GISs is *Cartography and Geographic Information Systems.*[33] This is the official journal of the American Congress on Surveying and Mapping. It is a very technical journal and most archivists will not find it of use in working with GISs. However, it occasionally publishes excellent and informative discussions on GIS issues, such as the design of a metadatabase for describing GIS data, and a very interesting recent essay that forecasts spatial data needs and outlines the future of a national mapping program. This latter essay, which appeared in 1990, is very useful for understanding who is developing the core GIS data products that populate most systems in the United States.

Archivists will find *GIS World*[34] much more user-friendly and easier to understand. This trade magazine is devoted to news about GIS technology and its application. It is not associated with any particular GIS vendor, and it features well-written essays on technical and policy aspects of

[29]*Document Image Automation* (Westport, Conn.: Meckler). Bimonthly. ISSN 1054–9692.

[30]*Optical Information Systems* (Westport, Conn.: Meckler). Bimonthly. ISSN 0886–5809.

[31]Urban and Regional Information Systems Association, *1992 Annual Conference Proceedings* (Washington, D.C.: URISA, 1992).

[32]*URISA Journal* (Madison, Wis.: University of Wisconsin Press). Quarterly. ISSN 1045–8077.

[33]*Cartography and Geographic Information Systems* (Bethesda, Md.). Quarterly. ISSN 1050–9844.

[34]*GIS World* (Fort Collins, Colo.). Monthly. ISSN 0897–5507.

GISs. The magazine is written for users of GIS technology, but occasionally it features important discussions of data management, data structures, geographic data policies, and applications that may generate archival data. *GIS World* is one of the better general magazines for keeping up to date on the basics of GIS technology and its application.

Bibliographic Access to Literature

Negotiating the literature of information science and computer science requires archivists to use several resources. Below is a brief list of some of the easier-to-use resources that are widely available in libraries.

Library Literature,[35] published by the H.W. Wilson Company, is perhaps the best-known bibliographic resource for library and information science literature. It indexes journal articles, conference proceedings, and books by title, subject, and author. *Library Literature* is a standard index, similar in format to the popular *Reader's Guide to Periodical Literature.* It provides no abstracts, but it indexes virtually all the literature produced in the library and information science field, including archival literature. *Library Literature* is published monthly and in a cumulative annual volume. It is also available on CD-ROM.

Library Literature is the best index to the literature of library and information science, but it offers no classification or evaluation of the materials it lists. Two excellent abstract journals to this literature make it much easier to judge a particular resource. The first, *Library and Information Science Abstracts (LISA),*[36] is published monthly in Great Britain by Bowker-Saur. Each issue contains approximately 600 abstracts of library and information science literature, including journal articles, government reports, conference proceedings, books, and dissertations. *LISA* is a fine resource for European literature and is also available on CD-ROM.

The other abstract journal is based in the United States. The Plenum Press publishes *Information Science Abstracts (ISA),*[37] but the editorial board contains representatives from the major organizations in library and information science. *ISA's* goal is to "promote the science, management, and technology of information by providing coverage of the world's literature." *ISA* covers a subset of the literature indexed in *Library Literature,* with 800 abstracts per issue. No year-end cumulative issue is published.

The literature surrounding information science and technology is very broad, and it is therefore difficult to identify the critical resources for researching any given topic or subject area. The *Annual Review of Information Science and Technology (ARIST)*[38] is a resource for reviews of literature generated in the field and for analytical essays of trends in specific topical areas. *ARIST* has been published annually by ASIS since 1966. *ARIST* describes and appraises activities and trends in the field of information science and technology. Each annual volume reviews numerous topics within the broad field of information science and technology. No single topic is treated on an annual basis. Topics are selected on the basis of their timeliness and reader interest. The 1991 volume included essays on information technology standards; expert systems; optical-imaging technology; information systems, services and technol-

[35]*Library Literature* (Bronx, N.Y.: H. W. Wilson). Monthly. ISSN 0024–2373.

[36]*Library and Information Science Abstracts* (London: Library Association). Monthly. ISSN 0024–2179.

[37]*Information Science Abstracts* (New York: Plenum Press). Monthly. ISSN 0020–0239.

[38]Martha E. Williams, ed., *Annual Review of Information Science and Technology,* vol. 26 (Medford, N.J.: Learned Information Inc. for the American Society for Information Science, 1991). ISBN 0–938734–55–5; ISSN 0066–4200.

ogy for the humanities; and an excellent essay on the role of literature on communications and organizational culture in the information science field. Archivists will find *ARIST* a worthwhile resource for beginning any research in a specific topical area. Although an index itself, *ARIST* is indexed by the other indexes and abstract journals for information science listed here.

The bibliographic tools for accessing computer science literature may not be as familiar to archivists as those for library and information science, but there are some excellent resources for probing this domain of literature. Fortunately, members of this field understand both the diversity of literature available and the depth of materials on most topics. Archivists will welcome the excellent tools that review and abstract this literature and classify it into logical topical areas for better and more informed access.

ACM Computing Reviews[39] is the review journal of the Association for Computing Machinery. It is published monthly and contains full reviews of approximately one thousand monographs, journals, dissertations, and conference proceedings annually. *Computing Reviews* "aims to furnish computer-oriented persons in mathematics, engineering, the natural and social sciences, the humanities, and other fields with critical information about current publications in any area of the computing sciences." The companion to *Computing Reviews* is the annual *ACM Guide to Computing Literature*.[40] The *Guide* is one of the best sources of access to computing literature, containing over 22,000 citations to computing literature. The most useful aspect of *Computing Reviews* and the *Guide* is the classification system used to organize and provide access to the literature. The classification scheme was revised in 1991 to include the following primary headings:

General Literature
Hardware
Computer System Organization
Software
Data
Theory of Computation
Information Systems
Computing Methodologies
Computer Applications
Computing Milieux

Each of these headings is subdivided into three subcategories. Archivists will be particularly interested in the Data Structures subheading of the Data section, in the Information Storage and Retrieval subheading of the Information Systems section, and in the Computers and Society and the Management of Computing and Information Systems subheadings of the Computing Milieux section.

Computer and Information Systems Abstracts Journal[41] is published monthly by Cambridge Scientific Abstracts. The December issue serves as the index to the year. The issues are not cumulated. Annually, the journal contains 17,600 abstracts of international journal articles, government reports, conference proceedings, books, and dissertations from the computer science fields. Entries are cross-referenced and indexed by subject and author. The journal is divided into five main sections: Computer Software, Computer Applications, Computer Mathematics, Computer Electronics, and General Topics. Although this journal offers much less coverage than the *ACM Guide to Computing Literature,* the abstracts are very well written and may save the user a lot of time.

[39]*Computing Reviews* (New York: Association for Computing Machinery). Monthly. ISSN 0010–4884.

[40]*ACM Guide to Computing Literature* (New York: Association for Computing Machinery). Annual. ISSN 0149–1199.

[41]*Computer and Information Science Abstracts Journal* (Riverdale, Md.: Cambridge Scientific Abstracts). Monthly. ISSN 0191–9776.

There are more advantages to using this literature than there are difficulties in understanding it, but these advantages will never be realized without a clear understanding of what we hope to gain from using this material. The CART educational curriculum presents a well-defined set of goals for archivists for learning how to deal with electronic records and develop automated techniques for managing and making them accessible. The interdisciplinary approach stressed by the curriculum challenges archivists to look beyond their own profession to learn from others and, perhaps, to bring the unique archival perspective to bear on their work. By examining their literature to gain a better understanding of what our potential partners are all about, and by building on their work, archivists will be better positioned to join the chorus of voices addressing the variety of issues in the emerging information age.