

Metadata practices in digital libraries

A I M Jakaria Rahman^{1 2}, Enrico Francese²,
Muharrem Yilmaz², Wondwossen Beyene²

Abstract

The paper enlightens the professional environment about metadata application in hybrid libraries from both a theoretical and a practical perspective. It examines the main problems related to the “hybrid” nature of libraries and the concepts “hybrid library” and “digital library” are discussed through an extensive literature review. The review covers the evolution of the different standards and schemes of metadata practice in libraries, it focuses on the metadata practices in a real-world scenario, and discusses metadata implications for the libraries that launched initiatives for digitization. A final review of some relevant practical cases leads to the conclusions.

Keywords: Digital library, Hybrid library, Metadata, Digitization

This paper has been delivered at the International Seminar “Vision 2021: the role of libraries for building digital Bangladesh” on 04 February 2011, organized by the Library Association of Bangladesh. This is a revise and update version.

Rahman, AIMJ., Francese, E., Yilmaz, M., & Beyene, W. (2011). *Metadata practices in digital libraries*. Proceedings of the International Seminar ‘Vision 2021: the role of libraries for building digital Bangladesh’ (p. 66–82). Dhaka: Library Association of Bangladesh.

¹ Corrospounding author: jakaria@gmail.com

² Erasmus Mundus scholars (2010 - 2012), International Master in Digital Library Learning (DILL), Oslo and Akershus University College, Norway; Talinn University, Estonia; and Parma University, Italy.

Introduction

During the last three decades, many libraries have adopted information technologies, and are providing public access to their material in digital form. Institutional repositories have been growing rapidly over the past ten years (Shoeb, 2010). In general, high pressure has been put on libraries to introduce digital solutions for improved services. Many libraries are already automated and provide accesses to electronic journals or digital materials. Libraries are planning to start digitization projects or are already in the way of digitization. Very seldom those libraries are fully digitized in real sense and thus remain 'hybrid' libraries. Now-a-days the higher education community are aware about the digital library technologies but without consistency of metadata practices, the often-stated ideal of a 'hybrid library', which integrates traditional and electronic resources, remains a remote possibility (Gartner, 2008). The key aspect to consider in order achieving a proper integration is the focus on metadata. Effective use of electronic resources is dependent on the creation of good quality metadata. In this paper, an initiative has been taken to unfold the practices of managing metadata for digital library projects that will provide the state of arts knowledge to the managers of hybrid libraries that are going to fully transform in digital one.

Objectives

The objectives of this paper are to identify the solutions taken by libraries to cope with the various collections and traditions. The paper tried to answer the following questions:

1. What kind of practices are in action with different collections of materials and different traditions of metadata management?
2. What type of lessons can be learned for the libraries that plan to start digitization projects?

Methodology

The study is based on a review of literature about hybrid libraries, digital libraries, metadata use and practices. This is the result of meticulous literature search mostly on the Web of Science Citation Index.

Hybrid and Digital Libraries

When the early digital library initiatives started in the 1990s, everybody was well aware that the full accomplishment of digital collections of documents would take a lot of time. The initial years of transformation of the libraries into digital libraries were seen as a transitional moment, in which both digital and print collections had to coexist. This “transitional moment” was initially referred to as “the hybrid library” in the literature and the term was certainly an important trend in the 90s, as witnessed by the deep literature review written by Oppenheim & Smithson (1999). According to them, it may track the origin of the term hybrid library in Sutton (1996), though its credit is taken by C. Rusbridge who uses it when talking about the eLib project (Rusbridge, 1998). The eLib (UK Electronic Libraries Program), started in 1994, can be considered as one of the first attempts to create a digital library.

The term ‘digital library’ first appeared in the literature in 1990 (Bawden & Rowlands, 1999) and (Yerkey & Jorgensen, 1996) define digital library as a “systems providing a community of users with coherent access to a large, organized repository of information and knowledge”. The digital library is not just one entity, but information sources are seamlessly integrated. (Yerkey & Jorgensen, 1996) insisted that digital libraries are electronic libraries in which large numbers of geographically distributed users can access the contents of large and diverse repositories of electronic objects - networked text, images, maps, sounds, videos, catalogues of merchandise, scientific, business and government data sets - they also include hypertext, hypermedia and multimedia compositions. Borgman (1999) explored the digital library from both research and library community view and stated digital libraries as a “set of electronic resources and associated technical capabilities for creating, searching, and using information (p. 42)”, it includes data and metadata such as representation, creator, owner, reproduction rights etc. Digital library as a organized collection of information where the information is stored in digital formats (Arms, 2000), and have a particilat method selection of materials, access and retrival (Witten, Bainbridge, & Nichols, 2009). Lesk (2005) predicted that half of the material accessed in major libraries will be digital by the early 21st century, and stated that digital libraries can provide services like delivery of information to the user’s desk and provide term- and phrase-based search facilities in collections of texts, sounds and images. The content may be scans of printed pages, illustrations or photographs, audio, video, and interactive material, both newly generated and converted from older material. The content must be accessible, relatively straightforward with a sophisticated interface software and retrieval system. It should also ensure that what is available today would still be available

tomorrow. Review of the above literature suggests that the digital library is the collection of services and information objects that support users in dealing with information objects, and the organization and presentation of those objects available directly or indirectly via electronic/digital means. For the purpose of this paper, a digital library encompasses both the collection and the expertise needed to interpret, offer intellectual access, and ensure the integrity over time of digital works to make it available for the users.

Metadata: what is it?

Metadata is the life of documents. Without mentioning metadata, it is hard to converse about digital libraries, data repositories, and many aspects of the library 2.0/web 2.0 environment as it became a vital part of digital information systems. However, what is metadata, and how it comes to use in digital preservation context? The etymology of metadata draws from the classical Greek prefix meta, which means ‘after, behind, or higher’ and from the Latin word data, plural for datum, which means ‘a piece of information’ or ‘something given’ (Greenberg, 2009). The term ‘metadata’ was coined by Jack E. Myers in the late 1960s, and registered in 1986 as a trademark of the computer software company Caplan (2003). In 1990, the perspective of using the term ‘metadata’ was modified for the sense of significant information to make computer files identifiable and useful to humans. Certain

Sen (2004) states that the concept of metadata has grown to a certain extent in the 1960’s. The first metadata consisted of simple file names, field names and field types, in the 1970s described data definitions and modeled by various data models. In the 1980s, with the advent of object-oriented programming, the metadata also consisted of class definitions and class hierarchies (aggregation and generalization).

In the early 2000s, major investments were generated by the recognition of the need for the creation of a metadata standard. This standardization need was fueled by the fact that unlike the software development, a data warehouse project needs heterogeneous tool and data environments. For example, in the data warehouse world, data quality tools, data modeling tools, ETL (Extract, transform, and load) tools and end-user tools were developed by different vendors with entirely different specifications. The integration using a metadata standard allows them to communicate with each other. The data in a data warehouse can also be of various types and format and a standardization effort will also help in data integration.

The following figure 1 explains the life of the metadata from its initiatives in the 60's to its current status:

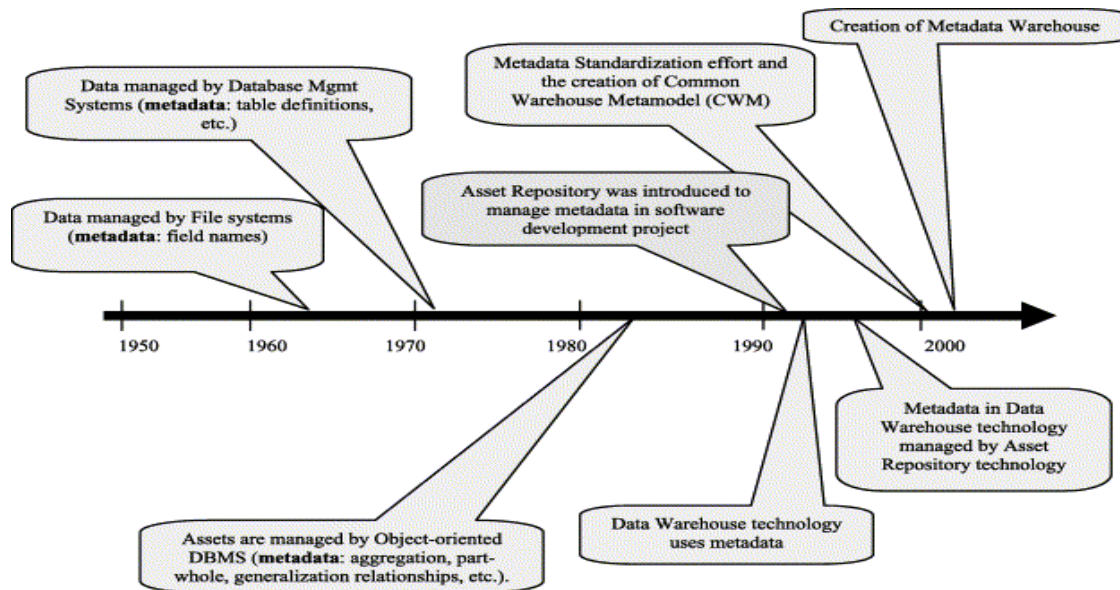


Figure 1: The time line for metadata management (Sen, 2004).

Definition of metadata depends on the diffuse environment of use. According to Dempsey and (Dempsey & Heery, 1998, p. 149) metadata is “data associated with objects which relieves their potential users of having to have full advance knowledge of their existence or characteristics”. Metadata is the structured information about information resources or any media type or format (Caplan, 2003) like the ‘extra baggage’ associated with a resource (Miller, 2003) and help to find the resource while in search. According to (National Information Standards Organization, 2010, p. 1), “metadata is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use or manage an information resource”. The Dublin Core Metadata Initiative Glossary (DCMI, 2005) defines metadata as “data associated with either an information system or an information object for purposes of description, administration, legal requirements, technical functionality, use and usage, and preservation”. With the explosion of the internet and the Web, initially metadata was applied to illustrate information stuff found there (Caplan, 2003), later the term came with the development of digital documents, referred to standards for describing, classifying, and locating electronic resources, and networked information. The term has been widened to cover all standardized descriptive information for both digital and non-digital resources. Subsequently, the term included in library catalogues and indexing tools as well as archival finding aids for any kind of documents (Chu, 2003; El-Sherbini & Klim, 2004).

In a nutshell, metadata can be identified as the foundation of all information retrieval. It is the key to guarantee that resources will stay alive and continue to be accessible into the future. Without adequate metadata, one is not able to locate information sources any more. The non-retrievable documents then become traceless, forgotten or most likely deleted. As a result, this unplanned loss of information may have significant and costly penalty for a society.

Metadata schemas and digitization

An important part of planning for a digital project is the selection of an appropriate metadata scheme. Lopatin (2010) quoted Foulonneau & Riley (2008) that several factors should be considered while selecting metadata schemes, including the type of institution, staff expertise, the purpose and structure of the metadata standard, the materials to be digitized, interoperability, and the objectives of the project. The organization should first determine the local needs, that is, ‘what functions the metadata needs to serve’ (Beall, 2007; Lopatin, 2010). Several authors stress the importance of controlled vocabularies for retrieval. (Baca, 2003), in discussing controlled vocabularies, asserts that “unless the metadata elements or data structure are populated with the appropriate data values (terminology), the resource will be ineffectual and users will not be able to find what they are looking for, even if it is actually there”. There are several commonly used controlled vocabularies and thesauri to choose from, depending on the needs of the project. They include Library of Congress Subject Headings (LCSH), Library of Congress/NACO Name Authority File (LC/NACO NAF), Thesaurus of Geographic Names (TGN), Library of Congress Thesaurus for Graphic Materials (LCTGM), and the Art & Architecture Thesaurus (AAT) among others (Lopatin, 2010).

Metadata is not always created by library professionals, or even by the authors. A relatively new trend, part of Web 2.0, is metadata created by end-users (often called folksonomy or social tagging). This is quite different from the use of controlled vocabularies, which provide a “consistent and detailed description . . . in a hierarchical, structured manner’ (Matusiak, 2006; Lopatin, 2010) whereas “Social classification represents a new approach to organizing content in the web environment where users create their own textual descriptors using natural language terms (tags) and share them with a community of users” (Matusiak, 2006, p. 287). The increasing size of digital libraries and the diversity of materials, coupled with the need of

the users to have a single access point to all types of information has remained a challenge in the world of digital libraries. Trying to show how libraries are doing in this respect, The Library of Congress manages the diversity of its collections organizing them under different units such as Print and Photographs, Manuscripts, Geography and Maps, each managing a relatively homogeneous collection (Marchionini, Plaisant, & Komlodi, 1998). The National Library of Medicine has MARC records for books and Medline indexes for journal articles, and nevertheless, this scheme has posed problems for non-experienced users of the library (Arms, 2000). The National Science Digital Library (NDSL) collects materials with scientific significance including data sets about volcanoes and earthquakes; digitized versions of kinematics models from the nineteenth century; sound recordings, images, and videos of birds; and mathematical theorems and proofs regardless of their formats and invited mixed metadata content (Arms & Arms, 2004). The American Memory of the Library of Congress contains photographs, posters, published books, personal papers of presidents, maps, sound recordings, motion pictures, and other materials in digital forms. Yet as the aforementioned researchers indicated, users of both libraries want to have a single access point for exploring the whole collections. For this reason, they pointed out that the traditional schemes are not well adapted to the mixed content.

Metadata practices in real world

To identify the real world projects of digitization and metadata practices, we have examined the practice in academic, non-academic libraries, and research libraries. For this purpose a literature review has been done and the findings of the above-mentioned literature's are depicted below:

1. Metadata standards in use

Ma (2006) reports that the majority of research libraries use MARC (Machine-Readable Cataloging) while Lopatin, (2010) pointed that the majority of the non-academic libraries were using Dublin core as metadata scheme. However, both Lopatin and Ma indicate that there are plenty of Non-MARC metadata schemes including Metadata Object Description Schema (MODS), Metadata Encoding and Transmission Standard (METS), Metadata for Images in XML (MIX), Text Encoding Initiative (TEI), Encoded Archival Description (EAD), Visual Resources Association (VRA Core 4.0), Goddard Core, and Federal Geographic Data Committee (FGDC) being in use. The libraries in China, including the national library, e.g. have a metadata standard called as Chinese Metadata Standard. However, MARC format is in

use in the Shanghai library but the library rearranged the MARC in its style - Chinese MARC (CNMARC). The Shanghai library has been using Dublin Core as metadata standard (Liu, 2004). The analysis of the different schemas and practices revealed the importance of the Dublin Core. As a 'lowest common denominator' it was broadly used, due to its simplicity, and it is in general very well known among librarians (Rettig, Liu, Hunter, & Level, 2009; Toy-Smith, 2010). Nevertheless, it is found that there were some uses of homegrown metadata standards (Ma, 2009).

2. Choosing a metadata scheme

Before choosing any metadata scheme the first thing is to get an overview of all the different vocabularies, standards and metadata schemas available or in use in the ongoing or past projects. The UALC (Utah Academic Library Consortium) and CSU (Colorado State University) Task Forces discussed the metadata schemas with respect to their global importance, rather than their effective use within the institutions (Rettig et al. 2008, and Toy-Smith 2010). On the other hand, Xu (2005), found that projects often start with the digitization of materials, and then in a second stage user surveys are used in order to decide the appropriate metadata schema. Lopatin's (2010) two main criteria for deciding metadata schema was 1) the types of materials to be digitized; and 2) the purpose of the project. However, for academic libraries the granularity of the metadata schema is much more important than for non-academic libraries, he adds. The approaches to choosing schemes are different: some start from the documents, others start from the metadata. Usually the reflection about metadata comes after the digitization projects have run for some time, in order to optimize the process. Digitization of documents comes first, because of the need to preserve and protect the collections. Metadata reflection comes to "put order" in all the former projects. It indicates that the choice of metadata has been taken according to the collections owned, to the context, i.e. a pragmatic choice.

3. Customization of or locally developed metadata schemes

Baca (2003) believes that there is no "one-size-fits-all" metadata scheme for describing all types of collections and materials that will satisfy every specific professional community. The interesting finding is that international metadata schemes do not always support the local needs, so there is a need of using locally developed metadata schemas for digitization of local history and events, local objects, such as postcards, images, video recordings, and manuscripts by the use (Ma, 2006 and Loftin, 2010). All the elements of a metadata schema

may not satisfactorily describe the digital objects, and a scheme needs to be edited for the respective project, by adding additional elements or changing labels that better fits the respective projects (Loptin, 2010). The core metadata set contains the majority of Dublin Core Metadata Set, but adds many supplementary elements for the description of intellectual properties and abstract format of digital resources (Liu, 2003). The purpose and the application of every field (stating, example, which fields are mandatory) were specified. For example, the Date element of DC (Dublin Core) needed to be qualified to allow a distinction between the original document (Date.Original) and the digitized version (Date.Digital). A major importance was given to the identifier element, to prevent duplication and overlapping, and to guarantee storage, transportation and persistence, a lot of effort was invested by CSU in developing a personal system to create unique identifiers for digital objects (Rettig et al 2008, and Toy-Smith 2010). Liu (2003) has found that most of the projects start from the main elements of any standard or international metadata schemas, but customize the schemes as needed to fulfill the purpose of the specific project or used the locally developed one.

4. Selection of vocabulary schemes

The selection of a vocabulary scheme requires more effort than the descriptive metadata schemes, since these contain the semantic information. UALC had an abundance of previous practices that spanned from the non-use of controlled vocabularies to the use of high-profile vocabularies like LCSH. The importance of controlled vocabularies was underlined, as an important way to add consistency. Nevertheless, CSU noticed that user-generated keywords are very important, since they provide additional ways of access to documents. Both approaches were considered in designing the specifications for the Subject/keyword field, which was made mandatory (Rettig et al. 2008, and Toy-Smith 2010). Ma (2009) showed that the ARL (Association of Research Libraries) were applying different controlled vocabularies such as thesauri, indexes, subject headings, authority files, and terms to metadata. According to Loption (2010), the primary vocabulary utilized by academic libraries is the LCSH whereas non-academic librarians primarily used locally developed controlled vocabularies in addition to LCSH. The top three vocabularies selected by academic libraries match the findings of Ma's survey of ARL member libraries: LCSH, LC/NACO NAF (Name Authority File), and AAT (Art & Architecture Thesaurus), in that order. Other vocabularies such as the LC Thesaurus for Graphical materials, I and II, Getty Thesaurus for Graphical materials I and II, Getty Thesaurus of Geographic Names, Getty Union List of Artist Names,

MeSH, and Geographic Names Information Services were also listed among the controlled vocabularies that the ARL member libraries have been applying to their metadata activities. The use of personal and local vocabularies is very widespread, developed by the libraries. LCSH is considered as a point of reference when it is about subject information.

5. Interoperability

Metadata interoperability is important for searching across different collections and databases (Chan & Zeng, 2006a, 2006b). Different metadata schemes and vocabularies are serving different user communities. Rettig et al (2008) identified that the UALC focused on the problem of “metadata consistency”: this had to be the first consideration when developing digital collections that would be harvested by services like OAIster, the WorldCat Metadata Harvesting Program, or (a more local case for UALC) the Mountain West Digital Library. Lopton (2010) found that most of the academic and non-academic libraries used the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) for data exchange. This result is comparable to the survey by Ma (2009), where the majority of ARL member libraries reported using OAI-PMH. At CSU, the possibility to create simple Dublin Core metadata for the OAI-PMH harvesting was taken into account when selecting their metadata scheme (Toy-Smith 2010).

Abundance of metadata standards, tools and software trigger the need for interoperability. Ma (2009) puts this fact, as a challenge for librarians and pointed out that the involvement of librarians to develop OAI-PMH and Metadata crosswalk and other standards shows the trend of the libraries moving from discovery of standards to seeking integration of a system. Some of the concerns reflected by the librarians involved in the survey were “lack of system-wide infrastructure”, “difficulty of integrating existing online collections with new ones on new platforms”, and the cost of maintaining consistency across different platforms. Ma recommended for the management of metadata to be aware of the life cycle of the digital objects and the need to focus on interoperability.

6. New library professional positions for creating and maintaining metadata

To manage digital resources, librarian’s responsibilities have changed, new staff is hired or third party vendors are getting involved in the projects. The creation of a new post named “metadata librarian” is one solution, another is to incorporate the metadata responsibility in

the cataloging departments. The staff involved in metadata activities was held titles like the metadata librarian, cataloger, support staff, programmer, archivist, database librarian/specialist, subject librarian/specialist, preservation librarian/specialist, and student workers. The organizational changes discovered involved creation of a new department for metadata, redefining roles, and changing department names to indicate metadata related responsibilities (Ma, 2008). Loptin (2010) found that a majority of the academic and non-academic libraries have created new positions with responsibilities for metadata for digital projects. In Ma's survey of ARL libraries she found that half of the ARL libraries have created a new metadata librarian position. Such initiatives lead to the birth of new roles and positions in the library staff. Traditional roles have changed, new staffs were hired or old staffs were moved to new mansions. Simultaneously, third party vendors were involved in the library work for metadata creation for a certain period. Yet another solution was to train old and new staff for new functions.

7. Selection of the metadata and vocabulary schemes

Selection of the metadata scheme and the controlled vocabulary are two vital choices during digitization planning processes. Loptin (2010) found that the metadata librarian is primarily the one who selects both of these; the most common alternative is to set up a group, consisting of various staff members. Often a group is comprised of staff members from different institutions working together, including catalogers, archivists, project managers and systems personnel. To develop best Metadata practice guidelines, both UALC and CSU formed a Task Force that included members from different backgrounds, proving a good practice of cooperation and integration. The UALC had the Digitizations and Cataloging committees working together for the first time. Four members composed CSU's Task Force: the metadata librarian, the digital content librarian, the head archivist and the college liaison librarian. The Task Force gained benefit by the joint-forces of different figures. The role of the Task Force was not concluded with the publishing of the Guidelines since these need to be maintained, updated, and enriched, e.g. through integrating more standards (Rettig et al 2008, and Toy-Smith 2010). Thus, for selecting the metadata and vocabulary schemes for a specific project, there is a high need of choosing the appropriate staff members for the projects. Implementation of metadata is a library-wide endeavor and not confined just within cataloging and metadata librarians, but should also involve subject librarians, project managers, systems personnel, technical staff, and other personnel.

Discussions and suggestions

1. Metadata is an essential part of any digital library project. Due to the diversity of the digital libraries no single standard suits for all kinds of digital library initiatives.
2. This study found that MARC was the dominant bibliographic standard, even through different local dialects, like CNMARC; Dublin Core becomes relevant when entering the digital age.
3. Before choosing a metadata scheme the digital library project should consider and examine all the different vocabularies, standards and metadata schemas available or in use in ongoing or past projects.
4. Implementing a metadata schema for a digital project needs to take into account the identification of users and materials, the purpose of the digitizing project, the elements needed for accessing items in the collection, the database design, and the implementation of content management system and/or cataloging system used to create and manage records.
5. Using an international metadata scheme cannot guarantee that it will serve the local need or the purpose of the specify project objectives, it is often necessary to modify some of the fields of the standard schemes that best fit the project.
6. When selecting vocabularies, the aspect of semantic information should be given emphasis. Though it is very common to use personal and local vocabularies developed by the libraries, using the standard and internationally accepted vocabularies should be considered as a point of reference for indexing subject information.
7. Interoperability is vital to ease the sharing of data created with diverse metadata schemes. Emphasis should be on supporting the OAI-PMH protocol, as it is found that the majority of the digital projects are using this.

8. The hybrid libraries should build up teams consisting of professionals and non-professionals to select the best metadata and vocabulary scheme for the project. For better output, they should be involved in the planning stage of the project, including selecting the metadata scheme.

Conclusion

Libraries are moving from the “library-only” world of MARC to the “hybrid” and the mixed digital universe. Based on the evolving information environment and user demands, metadata plays a fundamental role in describing, accessing, and managing information objects of different formats and media (Ma, 2009 and Loftin, 2010). However, the planning and creation of metadata are no longer confined to traditional library divisions, but it is spread throughout the organization. The digital revolution of the libraries is an inevitable result of the opportunities facilitated by digital technology and users’ needs. In this paper we have suggested procedures to use for libraries that plan to digitize their collections.

Acknowledgment

We also acknowledge funding from the European Commission under the Erasmus Mundus DILL Program.

References

- Arms, C. R., & Arms, W. Y. (2004). Mixed content and mixed metadata: Information discovery in a messy world. In D. Hillmann & E. Westbrook (Eds.), *Metadata in practice* (pp. 223–237). ALA Editions.
- Arms, W. (2000). How effectively can computers be used for the skilled tasks of professional librarianship. *D-Lib Magazine*, 6(7/8).
- Arms, W. Y. (2000). *Digital libraries*. Cambridge, MA: MIT press.
- Baca, M. (2003). Practical issues in applying metadata schemas and controlled vocabularies to cultural heritage information. *Cataloging & Classification Quarterly*, 36(3-4), 47–55.
- Bawden, D., & Rowlands, I. (1999). Digital libraries: assumptions and concepts. *Libri*, 49(4), 181–191.
- Beall, J. (2007). Discrete Criteria for Selecting and Comparing Metadata Schemes. *Against the Grain*, 19(1), 28.

- Borgman, C. L. (1999). What are digital libraries? Competing visions. *Information Processing & Management*, 35(3), 227–243.
- Caplan, P. (2003). *Metadata fundamentals for all librarians*. Chicago: American Library Association.
- Chan, L. M., & Zeng, M. L. (2006a). Metadata interoperability and standardization-A study of methodology, Part I. *D-Lib Magazine*, 12(6), 3.
- Chan, L. M., & Zeng, M. L. (2006b). Metadata interoperability and standardization-A study of methodology, Part II. *D-Lib Magazine*, 12(6), 4.
- Chu, H. (2003). *Information representation and retrieval in the digital age*. Maryland: USA: American Society for Information Science and Technology.
- DCMI. (2005). Dublin Core Metadata Initiatives Glossary. Retrieved December 3, 2010, from <http://dublincore.org/documents/usageguide/glossary.shtml>
- Dempsey, L., & Heery, R. (1998). Metadata: a current view of practice and issues. *Journal of Documentation*, 54(2), 145–172. <http://doi.org/10.1108/EUM0000000007164>
- El-Sherbini, M., & Klim, G. (2004). Metadata and cataloging practices. *The Electronic Library*, 22(3), 238–248. <http://doi.org/10.1108/02640470410541633>
- Foulonneau, M., & Riley, J. (2008). *Metadata for digital resources: implementation, systems design and interoperability*. Oxford: UK: Chandos.
- Gartner, R. (2008). Metadata for digital libraries: state of the art and future directions. Retrieved October 20, 2010, from http://www.webarchive.org.uk/wayback/archive/20140617025221/http://www.jisc.ac.uk/media/documents/techwatch/tsw_0801pdf.pdf
- Greenberg, J. (2009). Metadata and digital information. In M. J. Bates & M. N. Maack (Eds.), *Encyclopedia of Library and Information Science, Second Edition - (3rd ed.)*. New York: Marcel Dekker.
- Lesk, M. (2005). *Understanding Digital Libraries* (2nd ed.). CA: Elsevier.
- Liu, W. (2004). The new development of digital libraries in China. In *international symposium on digital libraries and knowledge communities in networked information society (DLKC'04)* (pp. 2–5). Tsukuba: University of Tsukuba.
- Lopatin, L. (2010). Metadata practices in academic and non-academic libraries for digital projects: A survey. *Cataloging & Classification Quarterly*, 48(8), 716–742.
- Ma, J. (2006). Managing metadata for digital projects. *Library Collections, Acquisitions, and Technical Services*, 30(1-2), 3–17.
- Marchionini, G., Plaisant, C., & Komlodi, A. (1998). Interfaces and tools for the Library of Congress national digital library program. *Information Processing & Management*, 34(5), 535–555.

- Matusiak, K. K. (2006). Towards user-centered indexing in digital image collections. *OCLC Systems & Services: International Digital Library Perspectives*, 22(4), 283–298.
- Miller, P. (2003). Metadata-what it means for memory institutions. In G. E. Gorman (Ed.), *International Yearbook of Library and Information Management* (Vol. 2004, pp. 3–16). Lanham, MD: Scarecrow Press.
- National Information Standards Organization. (2010, October 7). Understanding metadata. Retrieved from <http://www.niso.org/publications/press/UnderstandingMetadata.pdf>
- Oppenheim, C., & Smithson, D. (1999). What is the hybrid library? *Journal of Information Science*, 25(2), 97–112.
- Rettig, P. J., Liu, S., Hunter, N., & Level, A. V. (2009). Developing a metadata best practices model: The experience of the Colorado State University Libraries. *Journal of Library Metadata*, 8(4), 315–339.
- Rusbridge, C. (1998). Towards the hybrid library. *D-Lib Magazine*. Retrieved on 29 October 2010 from [hdl:cnri.dlib/july98-rusbridge](http://hdl.cnri.dlib/july98-rusbridge)
- Sen, A. (2004). Metadata management: past, present and future. *Decision Support Systems*, 37(1), 151–173.
- Shoeb, Z. H. (2010). Developing an institutional repository at a private university in Bangladesh. *OCLC Systems & Services: International Digital Library Perspectives*, 26(3), 198–213.
- Toy-Smith, V. (2010). UALC best practices metadata guidelines: A consortial approach. *Journal of Library Metadata*, 10(1), 1–12.
- Witten, I. H., Bainbridge, D., & Nichols, D. M. (2009). *How to Build a Digital Library, Second Edition* (2 edition). Burlington, MA: Morgan Kaufmann.
- Xu, Q. (2005). Content management and resources integration: a practice in Shanghai Digital Library. In *Digital Libraries: International Collaboration and Cross-Fertilization* (pp. 25–34). Shanghai, China: Springer.
- Yerkey, A. N., & Jorgensen, C. (1996). A Course in Digital Libraries. *DESIDOC Bulletin of Information Technology*, 16(1), 31–39.