**InterPARES 2 Project**

International Research on Permanent Authentic Records in Electronic Systems

**Description Cross-domain**

# Annotated Metadata Bibliography

**(Draft version)**

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February 2004

## Standards/Projects

**Burnett, Kathleen, Kwong Bor Ng and Soyeon Park (1999), "A Comparison of the Two Traditions of Metadata Development," *Journal of the American Society for Information Science* 50(13): 1209-1217.**

"This article examines the different conceptual foundations and orientations of the two major approaches contributing to the metadata discussion. An examination of the ongoing efforts to establish metadata standards, and a comparison of different metadata formats, supports a proposal for an integrated concept of metadata to facilitate the merging of the two approaches."

This article identifies the two approaches to metadata as, the Bibliographic Control Approach and the Data Management approach arising from the disciplines of Library and Information Science and Computer Science, respectively. The article examines the foundations, purpose and results of metadata in each discipline; Library and Info Science focus on resource discovery and search and retrieval functions of metadata while Computer science and Data Management communities focus on aspects of data use.

The article compares six current/in development metadata formats: Dublin Core, IAFA templates, WWW Sematic Header, URC (Uniform Resources Characteristic/Citation), OCLC InterCat project which employs USMARC format and the TEI (Text Encoding and Interchange) format. The writers of the article call for merging of the two approaches in order to best serve users of information as well as creator and data managers.

**Center for Intelligent Information Retrieval (CIIR), University of Massachusetts and Carnegie Mellon University, (2002), "*Digital Government Project*: A Language-Modeling Approach to Metadata for Cross-Database Linkage and Search," Bruce W. Croft and Jamie Callan, principal investigators.**
Internet on-line. Available from http://ciir.cs.umass.edu/research/digitalgovt.html [accessed February 5, 2004].

The Digital Government project is sponsored by the National Science Foundation. They propose government information systems that could locate, retrieve, and integrate desired information quickly, handling transparently the details of which databases contain the information or in what format it is presented. They propose an approach to metadata, which is based on language models instead of ontologies or controlled vocabularies. This web site provides a brief bibliography of published materials on this project to date.

**Center for International Earth Science Information Network (2001), *Metadata Standards*.**
Internet on-line. Available from http://www.ciesin.org/metadata/TOC/standards.html [accessed February 5, 2004].

This Web site briefly outlines and provides links to the following metadata standards.

- Anglo-American Cataloguing Rules (AACR2)
- Directory Interchange Format (DIF):
- Content Standards for Digital Geospatial Metadata (CSDGM):
- Government Information Locator Service (GILS):
- Machine-Readable Cataloguing (MARC):

**Dekkers, M. and S. L. Weibel (2002), "Dublin Core Metadata Initiative Progress Report and Workplan for 2002," *D-Lib Magazine* 8(2).**
E-Magazine on-line. Available from http://www.dlib.org/dlib/february02/weibel/02weibel.html [accessed February 5, 2004].

A progress report of the Dublin Core Metadata Initiative's mission to facilitate internet searches by developing metadata standards, frameworks for the interoperation of metadata sets and supporting community or disciplinary based metadata sets.

**Dempsey, L. and R. Heery (1998), "Metadata: A current view of practice and issues," *Journal of Documentation* 54(2): 145-172.**

"This paper describes emerging metadata practice and standards. It gives an overview of the environments in which metadata is used, before focusing on metadata for information resources. It outlines an approximate typology of approaches and explores different strands of metadata activity. It discusses trends in the format development, metadata management, and use of search and retrieve protocols. It concludes by discussing some features of future deployment of metadata in support of network resource discovery."

**Dodds, Douglas (1999), "Integrating access to distributed images: The Electronic Library Image Service for Europe (ELISE) Project," *Art Libraries Journal* 24(1): 40-42.**

Backgrounds the two phases of the ELISE Project, and the participation of the Victoria and Albert Museum. "ELISE is creating a generic interface that is designed to be applicable in different subject areas." The focus is on interoperability.

**Greenberg, J. (2001), "A quantitative categorical analysis of metadata elements in image-applicable metadata schemas," *Journal of the American Society for Information Science and Technology* 52(11): 917-924.**

Examines the image-applicability of the Dublin Core, VRA Core, REACH, and EAD metadata schemas. "The study found that each of the examined metadata schemas contains elements that support the *discovery, use, authentication* and *administration* of images." "The study introduces a new schema comparison methodology and explores the development of a class-oriented functional metadata schema for controlling images across multiple domains."

**Gilliland, Anne J. (2004), "Introduction to Metadata: Setting the Stage," in *Introduction to Metadata: Pathways to Digital Information*, Murtha Baca, ed. Online Edition, Version 2.1.**
Internet. Available from
http://www.getty.edu/research/conducting_research/standards/intrometadata/setting.html
[accessed February 5, 2004].

Includes a discussion of the evolution of the use of the word metadata over time and different disciplines. Gilliland discusses the need for structure and standards in creation of metadata in order for the benefits of metadata to come to fruition. Metadata provides; authenticity, determines structure and content, explores the relationships between and within information objects, provides intellectual and physical access, provides reference information. Metadata is broken down into distinct functions; administrative, descriptive, preservation, technical, use, and attributes and characteristics; source of metadata, method of metadata creation, nature of metadata, status, structure, semantics and level. The article identifies a lifecycle of information objects (– creation and multi-versioning—organization—searching and retrieval—Utilization—preservation and disposition) and discusses the metadata created and used at each stage of the life cycle. The article argues the importance of metadata—increased accessibility, retention of context, expanding use, multi-versioning, legal issues, preservation and system improvement and economics. Concluding that, "The existence of many types of metadata will prove critical to the

continued physical and intellectual accessibility and utility of digital information resources and the information objects they contain."

**Heery, Rachel M. and Harry Raup (2002), "A Metadata Registry for the Semantic Web," *D-Lib Magazine* 8(5).**
E-Magazine on-line. Available from http://www.dlib.org/dlib/may02/wagner/05wagner.html [accessed February 11, 2004].

"Explores the role of metadata registries and will describe three prototypes, written by the Dublin Core Metadata Initiative. Outlines how the prototypes are being used to demonstrate and evaluate application scope, functional requirements, and technology solutions for metadata registries."

**Lupovici, Catherine and Julien Masanès, *Metadata for the Long Term Preservation of Electronic Publications* (The Hague: Koninklijke Bibliotheek, 2000).**

This is a report of a study jointly funded by the European Communication's Telematics for Libraries Program. The objective of the report is to define the core minimum metadata for preservation management purposes. The report identifies the problem technical obsolescence will pose to the long term preservation of digital documents. The authors define 8 core metadata elements and 38 sub-elements, based on the OAIS information model, which are to be created in an automatic way in order to facilitate the handling of large numbers of documents.

**McKemmish, Sue, Glenda Ackland, Nigel Ward and Barbara Reed (1999), "Describing Records in Context in the Continuum: The Australian Recordkeeping Metadata Scheme," *Archivaria* 48 (Fall): 3-43.**
Article on-line. Available from http://journals.sfu.ca/archivar/index.php/archivaria/article/view/12715/13890 [accessed July 21, 2008].

"Presents the conceptual models…as a framework for standardising and defining recordkeeping metadata, introduces the [Australian Recordkeeping Metadata] Schema elements, and explores their extensibility through the metamodels employed to enable rigorous structuring and test validity." The Australian Recordkeeping Metadata Schema "uses recordkeeping understandings to make explicit connections between business, defined broadly to encompass all social and organizational activity, the people or agents who do business, and the records which are by-products of that business."

**Milstead, J. and S. Feldman (1999), "Metadata Projects and Standards," *Online* 23(1): 32-38.**
Article on-line. Available from http://www.onlinemag.net/OL1999/milstead1.html#projects [accessed February 11, 2004].

"The specific metadata standards and projects are described, including Dublin Core, the Federal Geographic Data Committee (FGDC) content standard for digital geospatial metadata, the Government Information Locator Service, the Warwick Framework, the Channel Definition Format, and the Metacontent Framework. The article also discusses the issues of content standards and vocabularies and digital identifier."

**National Library of Australia (2002), *Dublin Core Metadata Initiative*.**
Internet on-line. Available from http://dublincore.org/ [accessed February 11, 2004].

"The Dublin Core Metadata Initiative (DCMI) is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems."

**Paul, S. K. (2001), "Updates on Standards from a Global Perspective," *Library Hi Tech News* 18(7): 21-22.**

The paper "provides an update, as of mid-2001, on standards of interest to librarians, publishers, intermediaries of all sorts, and those concerned with the general area of intellectual property" It includes a brief discussion of the Online Information eXchange ONIX International metadata standard. This metadata standard is used to describe printed books and has been adopted by many on-line book retailers has been adopted in the USA, the UK, Germany, France, Argentina and is under consideration by Russia and many other countries.

**Quam, E. (2001), "Informing and Evaluating a Metadata Intitiative: Usability and Metadata Studies in Minnesota's Foundations Project." *Government Information Quarterly* 18(3): 181-194.**

Provides an introduction to Minesota's *Foundations* project, a collaborative project with the goal of providing, "effective tools for citizens to discover the environmental and natural resource information they need, and to integrate access to diverse information resource types across multiple domains." The project included three studies; needs assessment, Bridges web site user interface, and usability of controlled vocabulary in Dublin Core metadata. Based on the findings best practices guidelines were published. This article is a summary of the methods and techniques used in the project.

**Woodley, Mary "Crosswalks: the path to Universal Access? ," in *Introduction to Metadata: Pathways to Digital Information*, Murtha Baca, ed. Online Edition, Version 2.1.**
Internet. Available from
http://www.getty.edu/research/conducting_research/standards/intrometadata/path.html [accessed February, 2004].

Paper examines the recent conversion efforts which aim convert data from one database to a second and the development of crosswalks to support "conversion projects and semantic interoperability to enable searching across heterogenous distributed databases. Conversion attempts are a result of either the obsolescence of earlier databases or because of efforts to provide greater access to information. The paper examines two such projects and identifies the various problems of conversion, such as, misalignment between databases, systematic inoperability between the growing numbers of different metadata standards and the lack of universal authority controls for vocabulary.

## Government

**Baron, Jason R. (1999), "E-mail Metadata in a Post-Armstrong World," paper presented *Metadata '99: Third IEEE Computer Society Metadata Conference, 7 April 1999, Bethesda, Maryland, USA.***

This article discusses the judicial decisions regarding the federal government's (United States) electronic record keeping systems, specifically the case of *Armstrong v, Bush*. The article examines how the federal archivist and the Executive Office of the President have confronted the issues of long term preservation of office records; e-mail and word processing documents. The article discusses the case law decisions regarding the question of what is considered a 'complete' record and the necessity of connecting an electronic document to the context of its creation through metadata. Examining current and past research projects dealing with the development of metadata standards and requirements – the UBC project in collaboration with the Department of Defence and the Pittsburgh Project.

**Booth, Kietha (2002), "Mediating for Metadata Standards: Competing Demands of E-government Archivists and Librarians for Resource Description in New Zealand," paper presented at the *11th VALA Biennial Conference and Exhibition, 6 February 2002, Melbourne, Australia.*** Internet on-line. Available from http://www.vala.org.au/vala2002/2002pdf/05Booth.pdf [accessed February 16, 2004].

"Archives New Zealand focus on recordkeeping metadata which seeks to manage records as authentic and reliable evidence over time, compared with discovery metadata which seeks to enable the identification and location of a resource at a point in time. ANZ has sought to ensure a good fit between the NZGLS discovery level metadata and its development of new systems. They are developing a new information system which will capture and manage contextual metadata. This process has highlighted the significant need for cross-agency understanding and discussion, and the importance of maintaining and contributing to international standard development [of metadata] to ensure global inter-operability [of metadata] and transfer of information."

**Chan, Donna (1998), "Canadian Government Information Locator (GILS): an evaluation of the presentation, accuracy, and completeness of GILS record," *Canadian Journal of Information and Library Science* 23(4): 1-27.**

Discusses Canada's implementation of a GILS during the pilot project in 1996-97 was examined by random sampling. States that, issues of presentation are easily resolved; however, the papers were limited in their value by the lack of "abstract and controlled subject terms."

**Christian, E. (2001), "A metadata Initiative for Global Information and Information Discovery," *Government information Quarterly* 18(3): 167-180.**

This article introduces the difficulties inherent in searching the internet for information. The article proposes Global Information Locator Service (GILS) as a possible solution to the lack of interoperability of various databases and searching devices. It introduces basic concepts and design issues, with emphasis on the techniques by which GILS supports interoperability. It explains the practical implications of GILS for the common roles of organizations involved in handling information, from content provider through system engineer and intermediary to searcher. The article provides examples of GILS initiatives in various types of communities: bibliographic, geographic, environmental, and government.

**Government of Canada (2001), *Record Keeping Metadata Requirements for the Government of Canada*, produced by the Records/Document/Information Management (RDIMS) Working Group on Work Process and Practices (WPPWG) January 2001.**
Internet on-line. Available from http://www.imforumgi.gc.ca/documents/2001/meta/meta00-eng.asp [accessed July 21, 2008].

Outlines the metadata requirements for Canadian government records.

**Government of New Zealand (2002), *E-government in New Zealand*.**
Internet on-line. Available from http://www.e-government.govt.nz/ [accessed February 11, 2004].

Provides access to the metadata standards created by the New Zealand Government Locator Service (NZGLS) project. According to the web site NZGLS "has been taking care of the way in which government information and services - online and offline - are described now and how those descriptions should be managed over time."

**McKemmish, Sue and Dagmar Parer (1998), "Towards Frameworks for Standardizing Recordkeeping Metadata," *Archives and Manuscripts* 26(May): 24-45.**

This article focuses on Australian research projects relating to metadata. Within the framework of the Australian series system and the continuum view of records. The paper looks at the definition or recordkeeping metadata. It discusses the structure and methodologies of the Strategic Partnership with Industry – Research and Training (SPIRT) Record Keeping Metadata Project which, "aims to provide a framework for standardizing sets of recordkeeping metadata that can be attributed to records from their point of creation" The paper also discusses the connection between the SPIRT project and the Australian Government Locator System whose objective is to, "promote the visibility, accessibility and interoperability of government information."

**Moen, W. E. (2001), "The Metadata Approach to Assessing Government Information," *Government Information Quarterly* 18(3): 155-165.**

Serves as an introduction to the other articles in this issue that are all related to metadata. It also "provides a brief historical sketch of the development of GILS and offers several perspectives on the critical importance of metadata for resource description and resource discovery. Interoperability is presented as a key challenge in integrating access to the various government information locator services being deployed at state and Federal levels."

**Mullen, A. (2001), "GILS Metadata Initiatives at the State Level," *Government Information Quarterly* 18(3): 167-180.**

"Focuses on the use of metadata as a tool for providing access and managing information resources in Government Information Locator Services in the United States. Benefits of various metadata schemes; Methods of applying metadata; Means of integrating diverse metadata-based resources."

**Treasury Board of Canada Secretariat (2003), "IMRC – Metadata."**
Internet on-line. Available from http://www.tbs-sct.gc.ca/im-gi/meta/meta-eng.asp [accessed July 21, 2008].

Provides links to various other metadata projects. These project are displayed and organized either by topic, organization within the Canadian government, or by country (other than Canada).

**United Kingdom Cabinet Office, Office of the e-Envoy (2002), "E-Government Metadata Standard – e-GMS," April 2002.**
Internet on-line. Available from http://www.nhsia.nhs.uk/egif/pages/standards/e-Government_Metadata_Standard.pdf [accessed February 11, 2004].

"Lays down the elements, refinements and encoding schemes to be used by government officers when creating metadata for their information resources or designing search systems for information system."

**United States General Accounting Office (2002), "GAO Report to Congressional Requesters: Information Management Challenges in Managing and Preserving Electronic Records," GAO-02-586 (June 2002).**
Internet on-line. Available from http://www.gao.gov./newitems/d02586.pdf [accessed February 11, 2004].

## Digital Preservation

**Day, Michael (1999), "Metadata for Digital Preservation: An Update," *Ariadne* 22.**
E-Journal on-line. Available from http://www.ariadne.ac.uk/issue22/metadata/ [accessed February 11, 2004].

Paper is a review of recent developments relating to digital preservation of metadata. It introduces the problem of preservation of digital information as not only a technological problem but also an organizational one. The paper reviews some of the developments in the archives and records domain and describes the taxonomy of information object classes defined by the Reference Model for an Open Archival Information System (OAIS). The paper also examines developments in library based metadata projects. The paper concludes with a call for investigation into actual testing and application of various metadata standards.

**Day, Michael (1998), "Issues and Approaches to Preservation Metadata," paper presented at the *Joint RLG and NPO Preservation Conference: Guidelines for Digital Imaging, 28-30 September 1998, University of Warwick, Coventry*.**
Available from http://www.ukoln.ac.uk/metadata/presentations/rlg-npo/warwick.html [accessed July 21, 2008]

Discusses the issues of preservation metadata and its applicability to the long-term preservation of digital objects. "Preservation metadata is a specialised form of administrative metadata that can be used as a means of storing the technical information that supports the preservation of digital objects. In addition, it can be used to record migration and emulation strategies, to help ensure authenticity, to note rights management and collection management data and also will need to interact with resource discovery metadata."

**Day, Michael (1998), "Metadata for Digital Preservation," CEDARS Project Document AIW01, CEDARS Access Issues Working Group.**
Internet on-line. Available from http://www.ukoln.ac.uk/metadata/cedars/AIW01.html [accessed February 11, 2004].

Reviews metadata formats and initiatives in the specific area of digital preservation. It supplements the DESIRE *Review of metadata* (Dempsey *et al.* 1997). Briefly describes the state of the art in the area of metadata for digital preservation.

**Green, Ann, JoAnn Dionne and Martin Dennis (1999), "Preserving the Whole: A Two-Track Approach to Rescuing Social Science Data and Metadata," *CLIR Reports*, pub83 (Washington, D.C.: Commission on Library and Information Resources, June 1999).**
Inernet on-line. Available from http://www.clir.org/pubs/reports/pub83/contents.html [accessed February 8, 2004].

The report discusses migration as a strategy for the long term preservation of electronic records. The Commission examined two tracks "The preservation project's goals for the data track were to develop and evaluate a *process of migrating* digital numeric information from computer tape to hardware- and software-independent formats and to evaluate the utility of the resultant *formats*." The documentary track examined the various formats and issues surrounding digitization of documentation including image scanning, OCR, combinations of image and text (PDF format), and text encoding. The authors make the observation that, data sets will be useless with out the ongoing preservation of codebooks which relate the numeric data to meaningful fields of information.

**Lazinger, Susan S., *Digital Preservation and Metadata: History, Theory, Practice* (Englewood, Colorado: Libraries Unlimited, 2001).**

## Non-Textual Records and Metadata

**Hartley, R. J., F. C. Johnson and A. J. Oulton (2000), "Image, Audio, Text: A Review of Recent Research in Information Retrieval," *New Review of Information and Library Research* 6: 171-206.**

"Reviews recent research in information retrieval from text, audio and image databases." To "illustrate significant developments within the various strands of retrieval research and practice." "Current metadata standards do not adequately accommodate all the needs of non-textual media representation."

**Heck, Thomas F., *Picturing Performance: The Iconography of the Performing Arts in Concept and Practice* (Rochester, New York: University of Rochester Press, 1999).**

This book discusses the iconography of the performing arts. The book discusses the meanings of iconography, iconography and iconology in art history, applied and analytical traditions and methodologies concluding with a discussion of the future of iconography. It is in this last section where the connection between metadata and iconography is made. (p.215) The author notes that metadata standards will have an impact on the retrieval of images, and expresses hope that "our access to relevant images be furthered and facilitated, rather than obfuscated, by the efforts at intellectual and conceptual control that metadata promises."

**Miller, Joanne (1999), "The Cost of Creating Digital Images and Metadata by Museums," *Visual Resources* 14(4): 399-411.**

This article examines the cost centers involved in repositories producing digital images for distribution over a network, these costs include; content selection, image preparation, image transmission, data preparation and data transmission. Findings are based on the Museum Educational Site Licensing Project (MESL). The article briefly examines the procedures and costs of reformation existing data for use with the MESL dictionary and field structure.

**Seadle, M. (1999), "Preserving the Spoken Word," *Library Hi Tech* 17(3): 230-232.**

Metadata is one of the 6 issues identified as impacting the preservation of digitalized spoken word. Distinguishes between bibliographical and structural metadata and suggests practical/technical solutions.

**Visual Arts Data Service (VADS), (1997), "Visual Arts, Museums and Cultural Heritage Metadata Workshop 1997 Report."**
Internet on-line. Available from http://vads.ahds.ac.uk/reports/Metadata_workshop/metadata_index.html [accessed February 11, 2004].

"The workshop sought to discover the main concepts required for resource description and discovery within the visual arts, museums and cultural heritage disciplines. Contain[s] the Edinburgh Recommendations for visual arts, cultural heritage and museums metadata which were a direct response to the issues and problems raised at the workshop."

**Zeng, M. L. (1999), "Metadata Elements for Object Description and Representation: A Case Report from a Digitalized Historical Fashion Collection Project," *Journal of the American Society for Information Science* 50(13): 1193-1208.**

"This project's goal is to develop a catalog for a digitized collection of historical fashion objects held at the Kent State University Museum and to analyze and evaluate how well existing metadata formats can be applied to a fashion collection. Comparison and analysis of the formats resulted in the adoption of a modified VRA metadata format to catalog the entire digitized historical fashion collection."

## Description, Access and Retrieval

**Buttler, D. and T. Critchow (2002), "Using Metadata to Automatically Wrap Bioinformatics Sources," *Information and Software Technology* 44(4): 273-279.**

"Currently there are a huge number of bioinformatics sources available over the web. Accessing these sources manually is infeasible for individual biologists. Our goal is to provide a single point of access for scientists that will retrieve data from each applicable source. One fundamental problem is automating the retrieval of data from each site. We propose a meta-data description language to delineate both the steps required to retrieve data, as well as the mechanisms necessary to access the web site that contains the data. This description will enable the automatic generation of wrappers that can extract the appropriate data. Our meta-data language is based on DARPA Agent Markup Language-S (DAML-S), extending the description to include a grounding which details the mechanics of data access."

**Gill, Tony (2004), "Metadata and the World Wide Web," in *Introduction to Metadata: Pathways to Digital Information*, Murtha Baca, ed. Online Edition, Version 2.1.**
Internet. Available from
http://www.getty.edu/research/conducting_research/standards/intrometadata/metadata.html
[accessed February 5, 2004].

Discusses the application of metadata to facilitate web searches. One of the issues raised is that, "Both the 'granularity' and 'surrogacy' problems have at their root the need to describe the relationships between different objects in the various records describing those objects." Advocates web metadata standards. "The availability of a robust, secure, and semantically-powerful metadata architecture will…allow…archives to more effectively meet their own institutional missions in providing access to their information treasures."

**Graham, Margaret E. (2001), "The Cataloguing and Indexing of Images: Time for a New Paradigm?" *Art Libraries Journal* 26(1): 22-27.**

Looks at the applicability of Content-Based Image Retrieval (CBIR) technology for pictorial information. Suggests that CBIR would allow users to query by "similarity retrieval" which has potential to be more effective than keyword searches for retrieving images.

**Hedstrom, Margaret (1998), "How do Archivists Make Electronic Archives Usable and Accessible?" *Archives and Manuscripts* 26(May): 6-23.**

From an archival perspective - centered on the need to provide meaningful access to electronic records. The article identifies the uses of metadata to provide access to users, incorporating a discussion of the need to make the information contained in metadata accessible to the user. Argues that for metadata description to increase access "Archivists need to educate the next generation of scholars as well as the general public how to approach digital evidence with a questioning mind about how it was generates, why it was preserved and how it might be interpreted."

**Miller, Joanne (1999), "The Cost of Creating Digital Images and Metadata by Museums," *Visual Resources* 14(4): 399-411.**

This article examines the cost centers involved in repositories producing digital images for distribution over a network, these costs include; content selection, image preparation, image transmission, data preparation and data transmission. Findings are based on the Museum Educational Site Licensing Project (MESL). The article briefly examines the procedures and costs of reformation existing data for use with the MESL dictionary and field structure.

**Ryssevik, J. and S. Musgrave (2001), "The Social Science Dram Machine: Resource Recover, Analysis, and Delivery on the Web," *Social Science Computer Review* 19(2): 163-174.**

Explores how Networked Social Science Tools and Resources (NESSTAR) plans to "develop a common interface on the Internet with the data holdings of a large number of providers and disseminators of statistical information worldwide." It is designed to enable users to "locate multiple data sources across national boundaries, browse detailed metadata describing these data, analyze and visualize data online, and download the appropriate subsets of data in one of a number of formats for local use, all within a system that has "advanced user authentication procedures to prevent unauthorized use of data."

## On-Line Resources

**Minnesota Historical Society, "Metadata Resources."**
Internet on-line. Available from http://www.mnhs.org/preserve/records/metadataresources.html [accessed February 11, 2004].

This Web site provides an annotated bibliography of and links to metadata resources on the Web.

**Treasury Board of Canada Secretariat, "IMRC – Metadata."**
Internet on-line. Available from http://www.tbs-sct.gc.ca/im-gi/meta/meta-eng.asp [accessed July 21, 2008]

Provides links to various other metadata projects. These project are displayed and organized either by topic, organization within the Canadian government, or by country (other than Canada).

**UKOLN (University of Bath), "Metadata."**
Internet on-line. Available from http://www.ukoln.ac.uk/metadata/ [accessed February 11, 2004].

This Web site provides links to projects and initiatives UKLON has been involved in and provides links to metadata resources on the Web.

**University of Washington Libraries – Digital Collections (1999), "Metadata: Why Should We Care?"**
Internet on-line. Available from http://content.lib.washington.edu/METADATA/ [accessed February 11, 2004].

A succinct overview of why metadata is necessary. Provides links to other metadata overviews and metadata projects. Provides the basic programming needs for metadata.

## Miscellaneous

**Hedstrom, Margaret (1997), "Building Record-Keeping Systems: Archivists are Not Alone on the Wild Frontier," *Archivaria* 44(Fall): 44-71.**
Article on-line. Available from http://journals.sfu.ca/archivar/index.php/archivaria/article/viewFile/12196/13210 [accessed 21 July 2008].

The article focuses on the creation and methodologies to resolve electronic record keeping concerns, but mentions little about metadata. "Recent research on electronic records has produced proposals and models for adding functionality and procedural controls to information systems is that systems can protect the authenticity and integrity of records."

**Holowczak, R. D., F. J. Artigas, S. A. Chun, J. S. Cho and H. S. Stone (2002), "An Experimental Study on Content-Based Image Classification for Satellite Image Databases," *IEEE Transactions on Geoscience and Remote Sensing* 40(6): 1338-1347.**
E-magazine on-line. Available from http://www.computer.org/internet [accessed February 11, 2004].

Reports "a system that can automatically determine whether an ROI is visible in the image, and can incorporate this into the metadata for individual images to enhance searching capability. The goal is to annotate each image with metadata regarding a number of ROIs. An experiment with the system annotated 236 advanced very high resolution radiometer (AVHRR) images of the North Atlantic from a five-month viewing period with descriptors that expressed the visibility of an ROI centered on Long Island, NY."

**Houlding, S. W. (2001), "XML – An Opportunity for "Meaningful" Data Standards in the Geosciences," *Computers & Geosciences* 27(7): 839-849.**

This paper discusses the evolution of XML and other metadata standards within the context of Web-based activities and the benefits of developing XML standards for the geosciences specifically in relation to GIS standards. The article suggests that, "XML allows development of markup languages that describe what information is rather than how it should be presented. This allows computer applications to process the information in intelligent ways."

**Jokela, Sami (2001), "Metadata Enhanced Content Management in Media Companies," Ph.D dissertation, Department of Computer Engineering, Helinski University of Technology, Finland.**
Internet. Avaialble from http://lib.tkk.fi/Diss/2001/isbn9512256932/isbn9512256932.pdf [accessed 21 July 2008].

"This thesis introduces two abstract models, a component model and a process model. Both models assist in the understanding and analysis of electronic publishing of content for multiple media products and on multiple media platforms. When semantic metadata, ontologies, and improved publishing processes are available, new advanced content-based products, such as personalized information feeds, are possible."

**Medyckyj-Scott, *Metadata in the Geosciences: Papers Derived from a Symposium Sponsored by the UK Association for Geographic Information* (Loughborough: Group D Publications, 1991).**

A collection of articles all concerned with "the problems of managing metadata and of developing solutions to the problems of handling information about rapidly growing sources of data. The acquisition of remotely sensed data and data for using in Geographical Information Systems by geoscientists is contributing greatly to the proliferation of datasets and, as a consequence, it is in the fields of the geosciences that some of the major problems of metadata management are occurring and where the need for solutions to the problems are most urgent."

**Sowa, J. F. (2000), "Ontology, Metadata, and Semiotics," *Conceptual Structures: Logical, Linguistic, and Computational Issues, Proceedings – Lecture Notes in Artificial Intellegence* 1867: 55-81.**

This paper discusses metadata within a semiotic framework focusing on the internet as a series of signs; icons, indices and symbols. The author argues that, "current proposals for ontologies and metadata have overlooked some of the most important features of signs … by looking only at the signs themselves, some metadata proposals have lost sight of the entities they represent and the agents – human, animal, or robot – which interpret them … this article shows how the fundamental semiotic primitives are represented in semantically equivalent notations for logic, including *controlled natural languages* and various computer languages."