Enhancing the Quality of Metadata: Modular Approach to Digital Resource Lifecycle Management

Daniel Gelaw Alemneh and Mark Edward Phillips; Digital Projects Unit, University of North Texas; Denton, Texas

Abstract

Quality is a multidimensional concept. The two aspects of digital library data quality are the quality of the data in the objects themselves, and the quality of the metadata associated with the objects. Maintaining usable and sustainable digital collections necessitates maintaining high quality metadata about those digital objects. The University of North Texas Libraries recognize the strategic benefit of metadata as a means of ensuring long term access to its digital resources. This paper discusses issues related to digital resources management and describes how the University of North Texas Digital Projects Unit approaches metadata quality issues at various levels of the digital resources life cycle. It also suggests a number of metadata quality assurance procedures, tools, and associated quality assurance mechanisms.

Introduction

Digital libraries and supporting technologies have matured to the point where their contents and structures are incorporating complex and dynamic resources and services. The University of North Texas (UNT) Libraries have created an application framework for integrating diverse digital information resources from a multitude of participating institutions. The undertakings of the UNT Libraries include: the CyberCemetery, Congressional Research Service Reports Archive, the World War Poster Collection, Federal Newsmaps and other materials drawn from collections throughout the libraries.

One UNT Libraries digital libraries initiative, the Portal to Texas History (PTH) is a state-wide collaborative digital project that offers students and lifelong learners a digital gateway to the rich collections held in Texas libraries, museums, archives, historical societies, and private collections. It features digital reproductions of photographs, maps, letters, documents, books, artifacts, and more. In addition, Portal Primary Source Adventures that comply with TEKS (Texas Essential Knowledge and Skills) standards highlight relevant materials for young scholars and classroom teachers.

Considering the role of standardized metadata in digital resource life cycle management, the UNT Libraries actively promote metadata-based digital resource management. The existing metadata system empowers participating institutions to describe digital objects in a consistent way that provides for optimum searching, discovery, and retrieval, while ensuring long-term preservation of digital resources.

The UNT Libraries Metadata

The Portal to Texas History collaborators share a number of goals, including ensuring long-term, easy access to a wide variety of cultural heritage collections. The Portal provides a metadata framework that fosters a collaborative environment for participating institutions.

The UNT Libraries metadata element set comprises Dublin Core-based descriptive metadata along with detailed technical and preservation metadata elements that document how digital resources are created, formatted, arranged, identified, and sustained with application of appropriate preservation procedures. While promoting interoperability with widely accepted standards, the recommended UNT Libraries metadata elements allow flexibility at the local level to integrate existing and anticipated content, processes, and systems. The complete documentation is available at: http://www.library.unt.edu/digitalprojects/metadata/ [1].

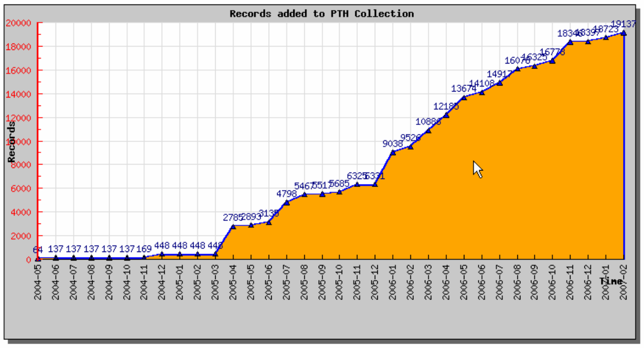


***Figure 1.** Metadata Records Added to the Portal to Texas History (from May 2004 to February 2007)*

As can be seen from Figure-1 above, the number of metadata records added to the Portal to Texas History has seen great increase and continues to rise at a consistent rate. As the volume and complexity of resources increased, the need for highly-developed resource management tools that could ensure quality and consistency became apparent [2].

Metadata Quality

Metadata quality is a crucial issue for cultural heritage communities. Metadata errors occur in a variety of forms, but when errors exist, in whatever form, they block access to resources. Metadata quality has a profound impact on the quality of services that can be provided to users. The problem is particularly acute if there are multiple institutions participating in a collaborative digitization project such as the Portal to Texas History, where a high level of interoperability is an important element.

The metadata quality characteristics depend on various factors, including: user perspectives, needs, and priorities, which vary across groups of users [3]. Metadata researchers have assessed metadata record quality by examining subject term specificity and exhaustivity, metadata record completeness, and other known substantive factors [4], [5]. The literature documents metadata quality in terms of:

- Error free, (such as adding/selecting wrong information in the wrong field/subfield, typographical errors):
  - Letter transposition, e.g., 0207 for 2007
  - Letter omission, e.g., Socity for Society
  - Letter insertion, e.g., asnd for and
  - Letter substitution or misstrokes, e.g. anu for any
- No omissions, (e.g., incomplete information)
- Non-ambiguous. (e.g., multiple spellings, multiple possible meanings, mixed cases, inconsistency, etc.)

Although no consensus has been reached on conceptual and operational definitions of metadata quality; all emphasize the importance of metadata quality. [4]. Errors, omissions, and ambiguities in the metadata affect the consistency of search results and high recall of available resources. [5]

In order for end users to benefit fully from the development of digital libraries, service providers and collaborators need to maintain a high level of consistency across diverse digital collections. The International Federation of Library Associations (IFLA) has identified four critical user information needs:

- **Find:** Various fields would be used as search criteria to find a specific resource.
- **Identify:** From the full record retrieved via a search, the most useful fields would display at the top level.
- **Select:** When multiple records result from a search, the short listing enables the user to quickly select the most useful records retrieved.
- **Obtain:** Obtain access to a resource.

Factors influencing metadata quality

Quality services depend on good metadata, but most metadata values are not very good [6]. Several metadata commentators identify factors that may influence metadata quality itself, and the effectiveness, efficiency, practicality, and scalability of the processes used to create it. [7].Based on the literature review and our own UNT experiences, the following section summarize the major factors that affect metadata quality. [8].

Local requirements

In order to understand existing or local requirements, the following issues should be considered and addressed:

- What type of objects will the repository contain? [Heterogeneity]
- What functionality is required locally? What are the associated digital rights issues? [Content packaging, repackaging and repurposing]
- How will they be described? And used? And by whom? [Granularity, determining purpose and level of detail]
- What entry points will be used? [The type of access, templates, interfaces, etc.]

Collaborators' requirements

Although collaborating institutions have much in common, they may have conflicting metadata requirements which may call for significantly different approaches. Library assumptions about metadata quality may not be appropriate in wider context. [7] To come up with effective, practical, and sustainable metadata creation processes, the following metadata quality influencing factors should be considered:

- What is the nature of the institutions' digital objects? [Museum objects, archives, historical documents, scholarly documents, etc.]
- How does the information-seeking behavior of their respective users differ? [Historians, genealogists, students, researchers, etc.]
- Does participation in the wider community impose specific requirements?
- What is required for interoperability? [Structure, semantics, and syntax.]
- Are requirements formal or informal?
- Will metadata be meaningful within aggregations of various kinds?
- Will access restrictions be imposed?

Training Issues

In most collaborative projects, non-professionals or volunteers create metadata, often working in isolation without adequate tools. Training issues greatly influence initial quality of metadata created. Some important considerations are:

- Who will be involved? What skills do they have?
- Are all actors qualified to produce the required metadata quality? [Very unlikely]
  - If not, what are the training needs?
- Are there adequate support mechanisms for those creating metadata? [Online tutorials, guidelines, FAQs, and other documentation]
- Is there sufficient supervision to ensure that actors receive regular feedback?

Cost

Creating and managing high quality metadata is an expensive endeavor [8]. Cost-effectiveness is an important factor that needs to be taken into account. Among other considerations:

- What resources are available locally?
- How can these resources be used to best effect?
- Are resources sufficient to produce the required metadata quality? [Very unlikely]
  - If not, what are the priorities? [Cost/Benefit]

Based on cost and benefit analysis, some lower metadata quality may be tolerated. The trade-offs between the various ways in which metadata quality can be improved and their costs can be considered.

All these issues significantly impact the quality of services including the consistency of search results and high recall of available resources. The impact of each factor, however, differs from institution to institution and even from project to project, depending on the type of repositories, economics, and the heterogeneity, size and scale of the collections and users.

UNT metadata quality assurance mechanisms

Responsible and viable metadata management activities should address a number of quality issues. The increase in the number and heterogeneity of digital resources has lead UNT to develop tools, workflows, and quality assurance mechanisms that allow for quick and effective metadata analysis and quality assurance.

The goal of the UNT Libraries metadata management team is to achieve metadata that is error free, without omissions, and non-ambiguous in order to enhance accuracy, relevance, accessibility, consistency, and coherence in our digital libraries. Accordingly, the UNT Libraries metadata management system provides cost effective and scalable mechanisms to detect errors and clean up values to improve the consistency and overall quality of data. The following section describes very briefly some of the tools and quality control mechanisms used at the UNT Libraries.

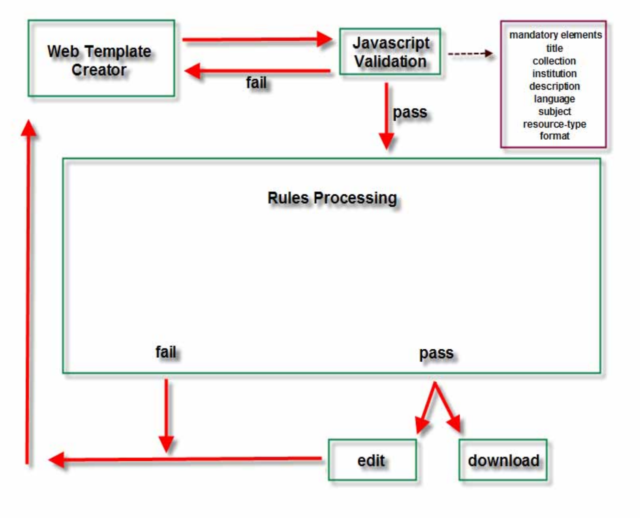
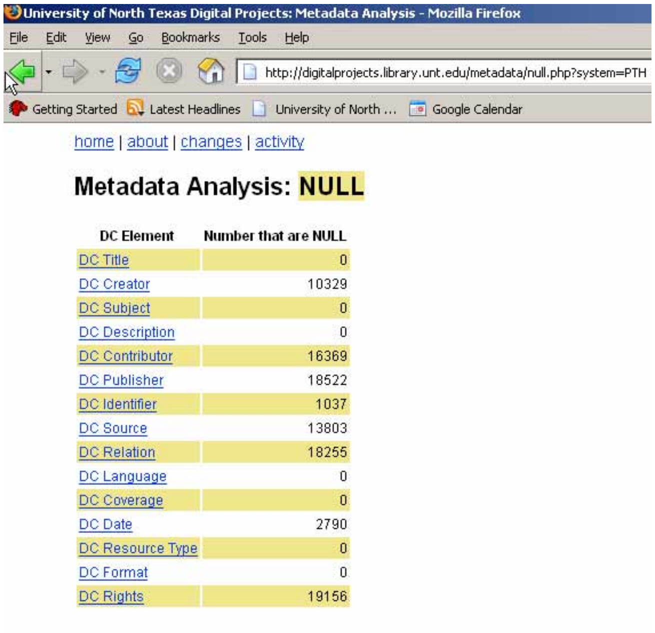


Figure 2*. Embedded quality assurance in metadata creation template*

The metadata template diagram in Figure-2 above shows one of the quality control tools in the UNT metadata creation workflow. It is a self-checking metadata entry template that ensures that all mandatory elements have values before the record is added to the system. In other words, no null value is allowed for mandatory elements.

Furthermore, an extensive suite of metadata analysis tools provide various analyses and reports. For example, as can be seen in figure-3 below, the null value analysis tool report confirms that all mandatory elements (Title, Subject, Description, Language, Coverage, Resource Type, and Format) are populated with metadata values.

In addition to the Metadata Template Creator and Null values analysis tools, the metadata system also provides other quality assurance mechanisms. For example, all values can be listed by element/field in aggregate and visually examined for errors and inconsistencies. The viewing tools are further enhanced by the use of additional refinements such as: *Highlighter* (On/Off), *Qualifiers* (Use/Ignore) etc. Furthermore, various graphical reports can be generated as needed. These include: Records Added over Time, Records Added per Month, Files Added over Time, Clickable Map of Texas, (by Collection, by Institution), etc.


University of North Texas Digital Projects: Metadata Analysis - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://digitalprojects.library.unt.edu/metadata/null.php?system=PTH
Getting Started
Latest Headlines
University of North ...
Google Calendar
home | about | changes | activity

Metadata Analysis: NULL

DC Element	Number that are NULL
DC Title	0
DC Creator	10329
DC Subject	0
DC Description	0
DC Contributor	16369
DC Publisher	18522
DC Identifier	1037
DC Source	13803
DC Relation	18255
DC Language	0
DC Coverage	0
DC Date	2790
DC Resource Type	0
DC Format	0
DC Rights	19156

Figure 3*. NULL value for visual inspection of UNT Mandatory elements*

Human created and maintained metadata is expensive. As depicted in figure 4 below, metadata records are also created by automated means, usually importing from other databases or harvested from the Web. However, fully automated maintenance and quality assurance may not be feasible due to variability of crawling technologies, and quality issues with the source data.

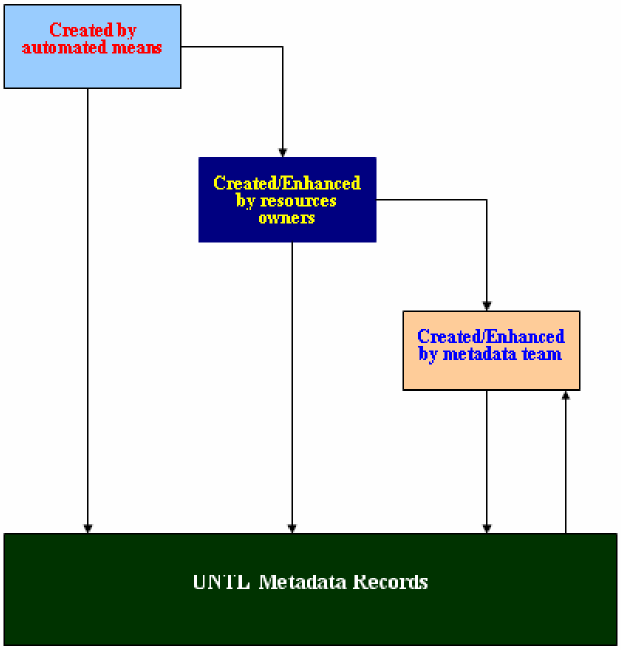

Created by automated means
Created/Enhanced by resources owners
Created/Enhanced by metadata team
UNTL Metadata Records

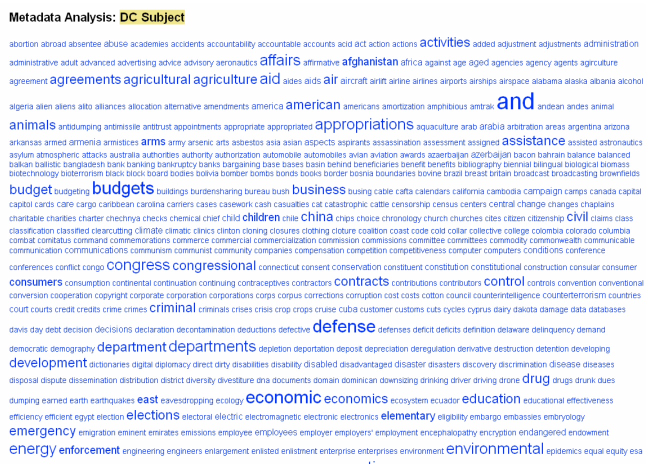
Figure 4*. General Workflow for UNT*

When we speak of metadata quality issues, in addition to the metadata structure and the creation of the content of the metadata fields, it is also important to discuss the quality of the vocabularies and taxonomies used to describe heterogeneous digital resources within metadata records.

The UNT Libraries Controlled Vocabularies

Successful metadata must add value that exceeds the traditional static representations. High quality metadata does not rely solely on information contained within the resource itself. The UNT Libraries have developed a system for creating and managing hierarchical controlled vocabularies for use in digital library initiatives.

Controlled vocabularies draw different terms and concepts into one single word or phrase to enhance search and navigation. These vocabularies enable data enterers to easily select appropriate values and place them in metadata records. Selecting a value from a controlled vocabulary ensures metadata consistency. Consequently, precision across all digital resources will be maintained.



Metadata Analysis: DC Subject

abortion abroad absentee abuse academies accidents accountability accountable accounts acid act action actions activities added adjustment adjustments administration
administrative adult advanced advertising advice advisory aeronautics affairs affirmative afghanistan africa against age aged agencies agency agents agirculture
agreement agreements agricultural agriculture aid aides aids air aircraft airlift airline airlines airports airships airspace alabama alaska albania alcohol
algeria alien aliens alito alliances allocation alternative amendments america american americans amortization amphibious amtrak and andean andes animal
animals antidumping antimissile antitrust appointments appropriate appropriated appropriations aquaculture arab arabia arbitration areas argentina arizona
arkansas armed armenia armistices arms army arsenic arts asbestos asia asian aspects aspirants assassination assessment assigned assistance assisted astronautics
asylum atmospheric attacks australia authorities authority authorization automobile automobiles avian aviation awards azaerbaijan azerbaijan bacon bahrain balance balanced
balkan ballistic bangladesh bank banking bankruptcy banks bargaining base bases basin behind beneficiaries benefit benefits bibliography biennial bilingual biological biomass
biotechnology bioterrorism black block board bodies bolivia bomber bombs bonds books border bosnia boundaries bovine brazil breast britain broadcast broadcasting brownfields
budget budgeting budgets buildings burdensharing bureau bush business busing cable cafta calendars california cambodia campaign camps canada capital
capitol cards care cargo caribbean carolina carriers cases casework cash casualties cat catastrophic cattle censorship census centers central change changes chaplains
charitable charities charter chechnya checks chemical chief child children chile china chips choice chronology church churches cites citizen citizenship civil claims class
classification classified clearcutting climate climatic clinics clinton cloning closures clothing cloture coalition coast code cold collar collective college colombia colorado columbia
combat comitatus command commemorations commerce commercial commercialization commission commissions committee committees commodity commonwealth communicable
communication communications communism communist community companies compensation competition competitiveness computer computers conditions conference
conferences conflict congo congress congressional connecticut consent conservation constituent constitution constitutional construction consular consumer
consumers consumption continental continuation continuing contraceptives contractors contracts contributions contributors control controls convention conventional
conversion cooperation copyright corporate corporation corporations corps corpus corrections corruption cost costs cotton council counterintelligence counterterrorism countries
court courts credit credits crime crimes criminal criminals crises crisis crop crops cruise cuba customer customs cuts cycles cyprus dairy dakota damage data databases
davis day debt decision decisions declaration decontamination deductions defective defense defenses deficit deficits definition delaware delinquency demand
democratic demography department departments depletion deportation deposit depreciation deregulation derivative destruction detention developing
development dictionaries digital diplomacy direct dirty disabilities disability disabled disadvantaged disaster disasters discovery discrimination disease diseases
disposal dispute dissemination distribution district diversity divestiture dna documents domain dominican downsizing drinking driver driving drone drug drugs drunk dues
dumping earned earth earthquakes east eavesdropping ecology economic economics ecosystem ecuador education educational effectiveness
efficiency efficient egypt election elections electoral electric electromagnetic electronic electronics elementary eligibility embargo embassies embryology
emergency emigration eminent emirates emissions employee employees employer employers' employment encephalopathy encryption endangered endowment
energy enforcement engineering engineers enlargement enlisted enlistment enterprise enterprises environment environmental epidemics equal equity esa

***Figure 5**. Word Cloud for UNT Libraries Subject/Keywords metadata elements*

Figure 5 above is a visual depiction of frequently used words in our subject metadata field. The word cloud simply illustrates keyword density (alphabetically) using font size. The more often a word appears on our metadata field, the larger it appears within the word cloud. This is important in identifying the subject areas that are highly represented in our collections.

Considering the diversity of participating institutions and heterogeneity of the collections, all possible digital resources may not be described adequately using pre-determined or controlled terms. To overcome the limitations and balance the issues, the UNT Libraries are implementing a hybrid system that uses both controlled terms and free keywords in order to describe all possible resources adequately. This flexible approach of pre-defined and custom-generated vocabularies provides maximum flexibility to capture complete and high-quality metadata for all types of digital resources.

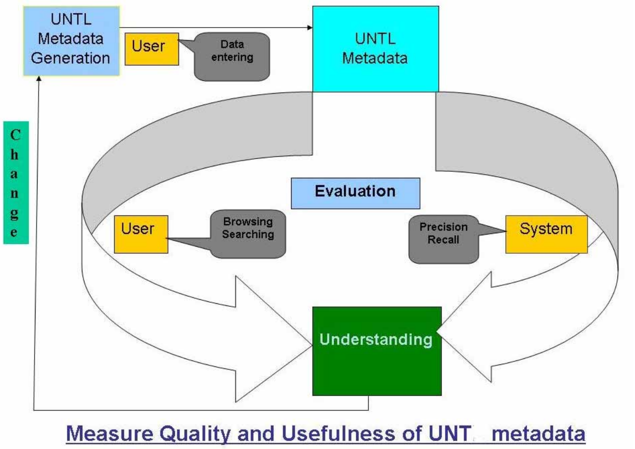


Figure 6. Quality assurance loop for UNT metadata workflow

Summary

Digital life cycle management starts from the point an item is created or selected for digitization (if not born-digital) and continues through image cleanup, metadata capture, derivative creation, and ensuring long-term access. Maintaining high quality metadata about every digital object requires a framework that provides the appropriate context needed to carry out quality assurance measures. As described in this document and summarized in Figure-6 above, the UNT Libraries metadata team approaches metadata quality issues at various levels of the digital resources life cycle. The team continually reviews and refines the metadata creation processes and makes them up-to-date and useful in light of current requirements and developments in the field. Such a modular approach facilitates the flexibility and responsiveness required in such a diverse and collaborative environment.

Conclusion

Maintaining usable and sustainable digital collections requires a complex set of actions. Quality metadata is crucial to implementing reliable, usable, and sustainable digital libraries. Metadata errors, omissions and ambiguities result in problems with recall and precision and affect interoperability.

The various quality control mechanisms applied at various levels of the metadata creation workflow facilitate improvements in metadata quality and optimise quality assurance processes throughout. Considering the complexities and multifaceted issues involved in determining the level of metadata quality required by all players, UNT Libraries' modular approach provides opportunities for continuous refinement in accordance with both local and wider context.

If the digital library community is to provide optimal access to the diverse information resources available across digital libraries and repositories, all stakeholders must give high priority to the task of creating and maintaining the highest possible level of metadata quality. Indeed, creation of good quality metadata requires a community-wide modular approach. By federating and utilizing quality assurance modules, we will be able to engage in scalable collaboration with the shared vision of building interoperable, usable, and durable digital libraries.

References

[1] The UNT Libraries Metadata Projects Documentation, available at: http://www.library.unt.edu/digitalprojects/documentation/metadata.htm

[2] Cathy Hartman, *et.al.*, "Development of a Portal to Texas History." *Library Hi Tech* 23, no. 2; 151-163. (2005). Available at: http://puck.emeraldinsight.com/10.1108/07378830510605124 [Site visited on March 06, 2007]

[3] Marieke Guy, Andy Powell, & Michael Day, "Improving the Quality of Metadata in Eprint Archives" in ARIADNE Issue 38, (January 2004). Available at: http://www.ariadne.ac.uk/issue38/guy/ [Site visited on March 06, 2007]

[4] Jane Barton, Sarah Currier, & Jessie Hey., Building quality assurance into metadata creation: an analysis based on the learning objects and e-prints communities of practice, Dublin Core Conference, Seattle,(2003) Available from: http://www.siderean.com/dc2003/201_paper60.pdf [Site visited on March 06, 2007]

[5] Marcia Zeng & Chan Lois Mai, Metadata Interoperability and Standardization – A Study of Methodology Part II." D-Lib Magazine Vol. 12, No. 6 (2006). Available from http://www.dlib.org/dlib/june06/zeng/06zeng.html [Site visited on March 06, 2007]

[6] Diane Hillmann, Naomi Dushay, & Jon Phipps, Improving metadata quality: augmentation and recombination. DC-2004, Shanghai, China, (2004). Available from http://www.slais.ubc.ca/PEOPLE/faculty/tennis-p/dcpapers2004/Paper_21.pdf [Site visited on March 06, 2007]

[7] Jane Barton & John Robertson, "*Designing workflows for quality assured metadata*" CETIS Metadata and Digital Repositories SIG meeting, (2005). Available from http://mwi.cdlr.strath.ac.uk/Documents/2005%20CETIS%20(MWI).ppt [Site visited on March 06, 2007]

[8] Brian Lavoie, & Richard Gartner *'Technology Watch Report: Preservation Metadata* DPC Technology Watch Series Report 05-01 (September 2005). Available from: http://www.dpconline.org/docs/reports/dpctw05-01.pdf [Site visited on March 06, 2007].

Authors Biography

Daniel Gelaw Alemneh *is Metadata and Documentation Librarian in the Digital Projects Unit at the University of North Texas Libraries. He currently coordinates and leads metadata related activities of the department. Daniel received his BS in LIS from Addis Ababa University, Ethiopia (1994), his MA in Library and Information Management from the University of Sheffield, UK (1997), and his Post Masters in Digital Image Management from the UNT (2000). Daniel is a doctoral candidate in information sciences and also an adjunct faculty member at the UNT School of Library and Information Sciences teaching indexing, abstracting, and information retrieval courses.*

Mark Edward Phillips *is Head of the Digital Projects Unit at the UNT Libraries where he oversees digital library development and all work in the digital laboratory. He received his Master's Degree in Information Science from the UNT School of Library and Information Sciences (2004) and a Bachelor in Music Performance from Oklahoma City University (2002). Mr. Phillips has been involved in statewide and national projects including the Portal to Texas History and the "Web-at-Risk" project—an NDIIPP funded project to capture and preserve digital information. The Web-at-Risk project is a 3-year collaborative effort with the California Digital Library, and New York University.*