

## Applying LIS Disciplines to the DMBOK Knowledge Areas

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**#EDW16**

# Speaker bio

- 25+ year career with experience in database administration, data architecture, and application architecture
- Current position is Enterprise Architect with Retail Payments Technology Services at the Federal Reserve Bank of Minneapolis
- The views expressed in this presentation are my own, and do not necessarily reflect the views of my employer or my university

# Why pursue the MLIS?

- After years of technical data management work, I found myself involved with work that had more questions but fewer answers
- While it may seem that technical skills related to data and information would be more difficult to develop and master, I have found the contrary is true
- To help find answers, I decided to pursue a Master of Library and Information Science degree at the University of Wisconsin-Milwaukee (fully online)

# From my grad school application

*Business priorities of most companies dictate that their application and information systems are implemented to meet business schedules. The systems are usually developed and maintained with an eye to cost and resource constraints. While these types of practices meet the need of the business, the knowledge of an organization's information, both structured and unstructured, becomes lost...*

# From my grad school application

*Another consequence is that the applications and their data are architected, developed, and maintained as silos. Disparate or redundant data is often the result, and can end up costing an organization more in the long term. As a potential solution, the collective information of an organization, from databases to reports to unstructured documents, should be considered a virtual library in itself. I believe the corporate world can learn much from the best practices of library and information science.*

# Partial list of courses completed for MLIS Information Organization concentration

- Foundations of Library and Information Science\*
- Organization of Information\*
- Information Access and Retrieval\*
- Introduction to Research Studies in Information Studies\*
- Digital Libraries
- Metadata
- Information Architecture
- Linked Data in Libraries: Mashups, Semantic Web & Web 2.0
- RDF, Ontologies and the Semantic Web
- Infopreneurship

\* = *core required course*

# Library and Information Science

- Library science has long standing tradition and discipline in organizing physical resources within the brick and mortar of a library
- More recently, Library and Information Science (**LIS**) disciplines aid in the organization of all types of resources, including digital

# Library and Information Science

- Information science defined in 1968 by Borko as an emerging discipline:
  - “An interdisciplinary science that investigates the properties and behavior of information, the forces that govern the flow and use of information, and the techniques, both manual and mechanical of processing information for optimal storage, retrieval and dissemination.”
- In whole, the disciplines of library and information science aid communities in satisfying information needs by organizing and providing access to available information resources



# Data Management

- Data Management (**DM**) defined as “the business function of planning for, controlling, and delivering data and information assets”
- (Many) interchangeable names include information management, enterprise information management, enterprise data management, data resource management, information resource management, and information asset management

# Our beacon: DMBOK

The goals of the **Data Management Body of Knowledge** are:

1. To build consensus for a generally applicable view of data management knowledge areas.
2. To provide standard definitions for commonly used data management knowledge areas, deliverables, roles, and other terminology, in conjunction with the DAMA Dictionary of Data Management, and thus, to move the Data Management Community towards standardization on concepts and activities.
3. To identify guiding principles for data management.
4. To clarify the scope and boundaries of data management activities.
5. To provide an overview of commonly accepted good practices, widely adopted techniques, and significant alternative approaches, without reference to specific technology vendors or their products.
6. To provide common organizational and cultural issues.
7. To identify strategies for data management maturity analysis.
8. To provide additional resources and reference material for further understanding of data management

# Our beacon: DMBOK

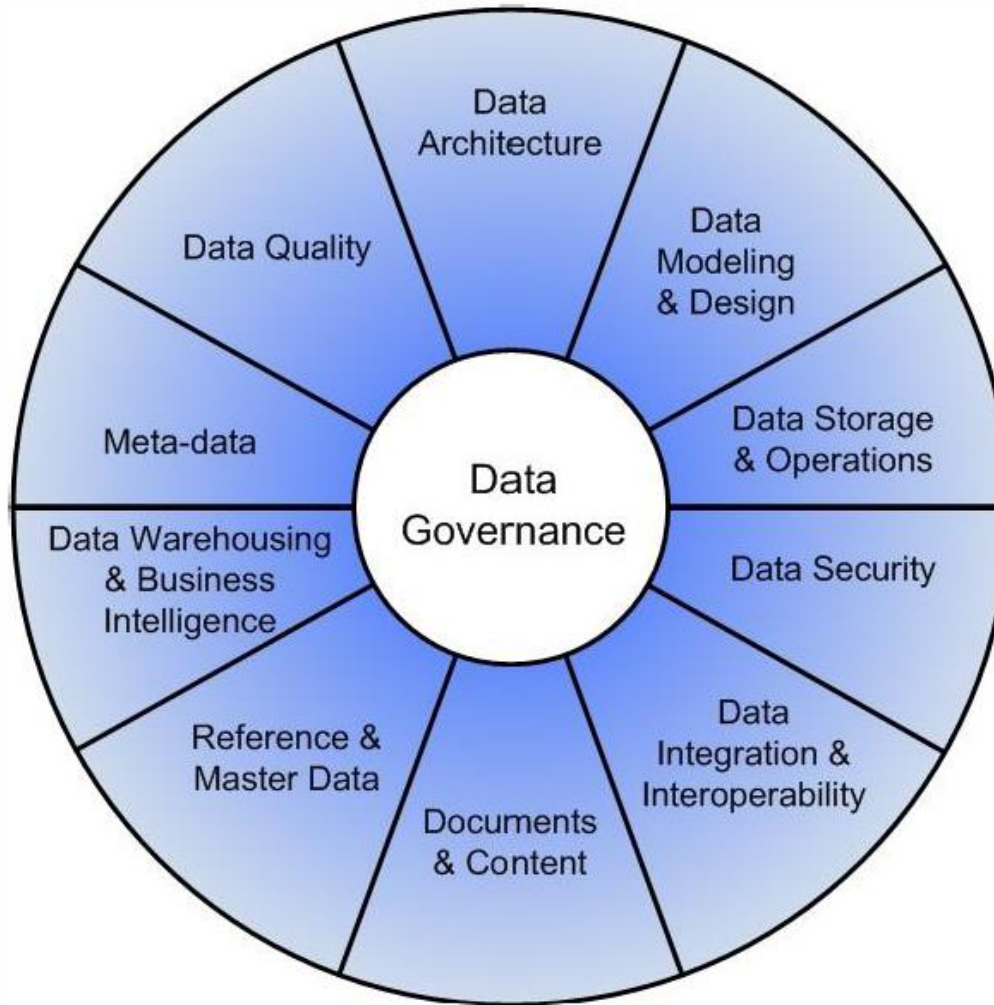
The guiding principles of the **Data Management Body of Knowledge** are:

1. Data and information are valuable assets.
2. Data and information must be managed carefully like any other asset by ensuring adequate quality, security, integrity, protection, availability, understanding, and effective use.
3. Share responsibility for data management between business data stewards who are trustees of data assets and data management professions acting as expert custodians of data assets.
4. Data management is a business function and a set of related disciplines.
5. Data management is an emerging and maturing profession with the IT field

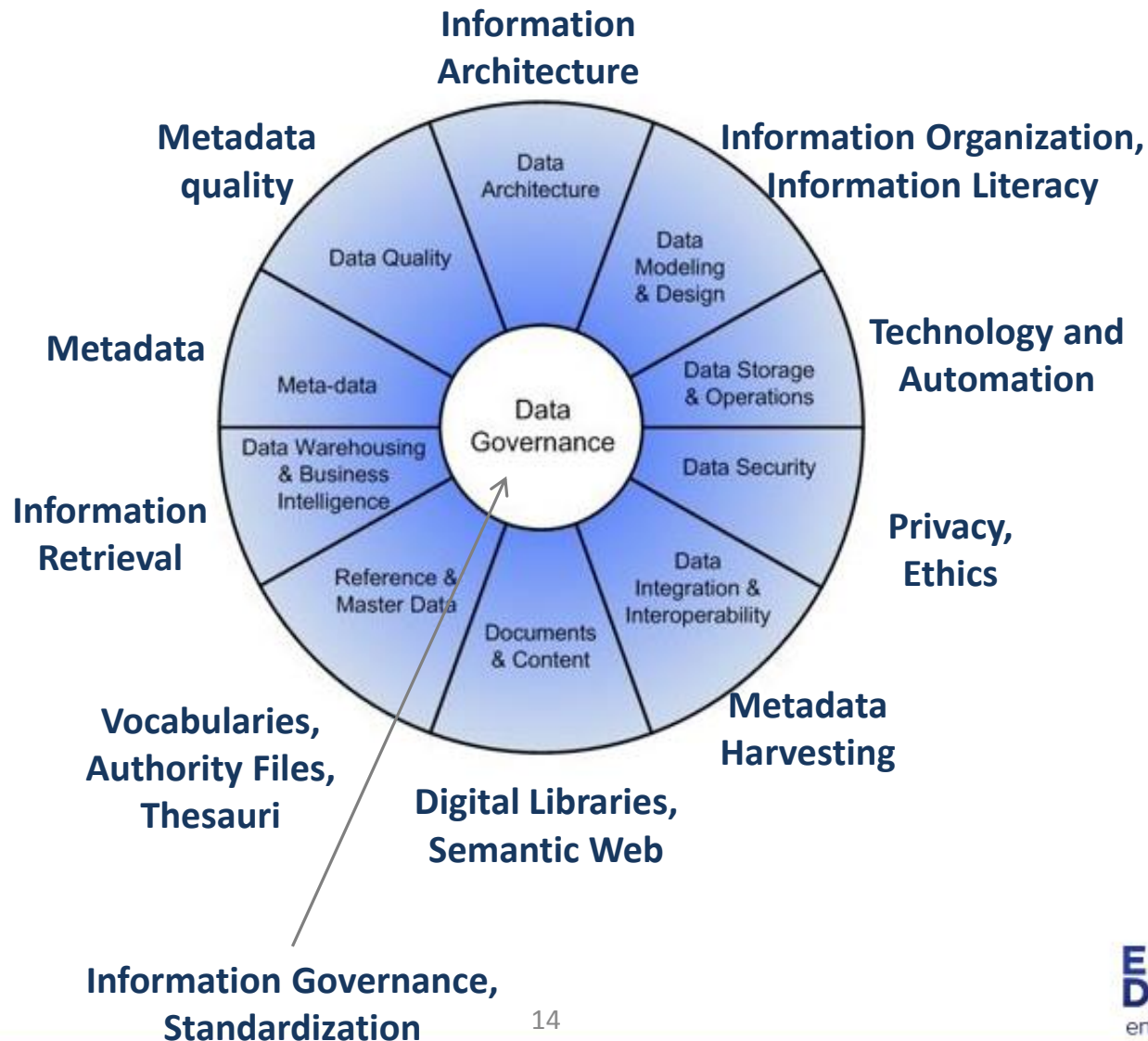
# My independent research study

- In Spring Semester 2014, I completed an independent research study entitled “Applying LIS Disciplines to the Knowledge Areas of Data Management”
- My paper explores the concept of aligning each of the DMBOK knowledge areas with counterpart disciplines in library and information science

# The Knowledge Areas of DMBOK2



# Mapping of DMBOK2 Knowledge Areas to LIS Disciplines



# Today's presentation

- Each knowledge area will be explored starting with Data Architecture at the 12:00 position on the wheel, proceeding through each knowledge area in a clockwise manner
- The title of each section is of the format:

**<DMBOK Knowledge Area> INFORMED BY <LIS Discipline>**



# DATA ARCHITECTURE INFORMED BY INFORMATION ARCHITECTURE



# What is Information Architecture?

- The combination of organization, labeling, and navigation schemes within an information system
- The structural design of an information system to facilitate task completion and intuitive access to content
- The art and science of structuring and classifying Web sites and intranets to help people find and manage information
- An emerging discipline and community of practice focused on bringing principles of design and architecture to the digital landscape

# Why does Information Architecture matter?

Cost and value propositions include:

- Cost of finding information
- Cost of not finding information
- Value of education
- Cost of construction of a website or system
- Cost of maintenance
- Cost of training
- Value of brand

# Why does Information Architecture matter to data management?

- To bring visibility to the underlying data architecture components and their relationship to the overall enterprise architecture, the discipline of information architecture should be applied to organize the data and the overall data architecture, much like a library
- Get back to basics with requirements

# The heart of requirements: FRBR

- Functional Requirements for Bibliographic Data (FRBR) serves these user tasks:
  - **Find** materials
  - **Identify** an entity
  - **Select** an entity appropriate for a user's need
  - **Acquire** or obtain access to information
- FRBR user tasks are a familiar mindset and behavior pattern of information consumers within a library, and a similar mindset can be applied to data architecture

# LIS opportunity 1

- Apply the principles of information architecture to overall data architecture
- Apply the FRBR user tasks of Find, Identify, Select, and Obtain as requirements for data architecture



# DATA MODELING & DESIGN INFORMED BY INFORMATION LITERACY

# What is Information Literacy?

- Involves concepts associated with information retrieval, requiring individuals to recognize when information is needed and to have the ability to locate, evaluate, and use effectively the needed information
- The context of information creators and users is very different
- Information creators should strive for maximum intelligibility and accessibility

# Opportunities for data modelers as information creators

1. Think about the readers
2. Focus on simple tools in order to achieve as much as is feasible, no more
3. Emphasize the ways information creators themselves can benefit from better-created information
4. Emphasize citing, reusing and linking to existing information as virtuous habits



# LIS opportunity 2

- Help users to locate, evaluate, and effectively use data models and metadata
- Use simple tools to communicate and share data models



# DATA STORAGE & AUTOMATION INFORMED BY TECHNOLOGY AND AUTOMATION

# Technology landscape

- The rapid evolution of cloud technology is changing the technology landscape across many industries, and the library is no exception
  - Library cloud technology examples include online catalog (OPAC) with cloud front ends, recommender systems, and discovery layers

# A collaborative mindset

- In comparison to business and industry, the library is:
  - a relatively homogeneous domain that operates on a worldwide scale
  - by nature encourages **collaboration** and **sharing**
- As the library achieves successes in cloud technology, the Data Storage and Automation knowledge area should seek to study lessons learned by libraries in order to advance cloud understanding by other domains

# LIS opportunity 3

- Explore the use of cloud technologies for data storage and services



# DATA SECURITY INFORMED BY PRIVACY AND ETHICS

# The library context

- Traditionally in the library context, the concern has been to provide open access to information resources to all (or to users with proper credentials if required), and to protect the privacy of patrons in terms of their usage of the information resources

# Divergent concerns

- The context of security as described by DMBOK and the context of privacy as described by the library context have different concerns:
  - The data management perspective seeks to secure an organization's data and information by granting access using the principle of least privilege and auditing who has accessed data
  - The library perspective seeks to give broad access to information but seeks to keep patron information access records private
- What could these divergent concerns possibly have in common?



# LIS opportunity 4

- Develop well-defined policies for information security and data privacy
- Provide ethics training in academic and workplace settings



# DATA INTEGRATION & INTEROPERABILITY INFORMED BY METADATA HARVESTING

# Integration and Interop

- In data management, data integration and interoperability is the acquisition, extraction, transformation, movement, delivery, replication, federation, virtualization and operational support of data
- In the library context, data interoperability is a concern in the area of metadata sharing, harvesting, and aggregating

# Metadata sharing

- In addition to its original context, metadata may need to be shared among multiple collections within an institution, among different institutions, and among external metadata services and repositories
- Most common means for metadata aggregation is through the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH)
  - OAI-PMH is based on expression of metadata in Simple Dublin Core format and on open standards including HTTP and XML

# Example DC XML

```
<?xml version="1.0" encoding="UTF-8"?>
- <oai_dc:dc xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/oai_dc/ http://www.openarchives.
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:dc="http://purl.org/dc/elements/1.1/"
  xmlns:oai_dc="http://www.openarchives.org/OAI/2.0/oai_dc/">
  <dc:title>View of Istanbul, Hagia Sophia in the center</dc:title>
  <dc:creator>Farrell, Shawn 1921-1999 photographer</dc:creator>
  <dc:subject>Ayasofya Müzesi Haghia-Sophia (Mosque : Istanbul, Turkey) </dc:subject>
  <dc:subject>Cities and towns</dc:subject>
  <dc:description>Includes buildings, cruise boat, and the harbor in the foreground.</dc:description>
  <dc:description>Title transcribed from photographer's notes.</dc:description>
  <dc:date>1955</dc:date>
  <dc:type>Stillimage</dc:type>
  <dc:type>Salted paper prints</dc:type>
  <dc:format>1 photographic print : salted paper ; 30 x 36 cm.</dc:format>
  <dc:format>image/jpeg</dc:format>
  <dc:identifier>HDL_0192847</dc:identifier>
  <dc:relation>Shawn Farrell Photograph Collection Farrell, Shawn 1921-1999 Restricted access: Material:
    only.</dc:relation>
  <dc:coverage>Istanbul (Turkey)</dc:coverage>
  <dc:coverage>Turkey</dc:coverage>
  <dc:coverage>Istanbul</dc:coverage>
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  <dc:rights>No known restrictions on publication.</dc:rights>
</oai_dc:dc>
```

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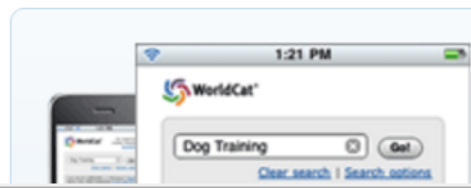
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Cabinology



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- ☐ Article (1)
- ☐ Print book (1)

### Refine Your Search

#### Author

[Dale Mulfinger](#) (1)

#### Year

[2008](#) (1)

[2001](#) (1)

#### Language

English

Results 1-2 of about 2 (.22 seconds)

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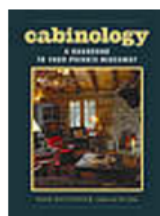
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Save

Sort by: Relevance

Save Search

☐ 1.



### [Cabinology : a handbook to your private hideaway](#)

by Dale Mulfinger

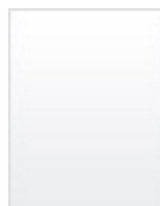
Print book

Language: English

Publisher: Newtown, CT : Taunton Press, ©2008.

Database: WorldCat

☐ 2.



### [Cabinology - Summer houses have been getting bigger and more traditional. Two new books argue that's a trend worth bucking. Also: Polling the critics-simple food done right... Let's get physical with the Mayo Clinic doctor... Is the new T-bird the beginning of a roadster revival?... and more.](#)

Article

Language: English

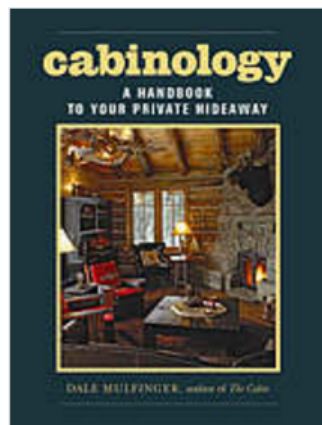
Publication: Fortune. 143, no. 14, (2001): 209

Publisher: [New York, NY, etc., Time, inc., etc.]

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# Cabinology : a handbook to your private hideaway

Author: [Dale Mulfinger](#)

Publisher: Newtown, CT : Taunton Press, ©2008.

Edition/Format: Print book : English

Database: WorldCat

Summary: A guide to knowing the best way to approach decisions regarding cabins, from choosing a site for a new cabin, to remodeling an old one, to getting the right fireplace. Throughout the book, there are photos of cabins small and large along with design tips, stories from other cabin owners around the country, and insights into getting a cabin of your own.

Rating: ☆☆☆☆☆ (not yet rated) 0 with reviews - Be the first.

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| 4.  <a href="#">Dakota County Library</a><br>Eagan, MN 55123 United States                      |   <a href="#">Book</a>     | 19 miles<br><a href="#">MAP IT</a> |  <a href="#">Library info</a><br> <a href="#">Add to favorites</a>   |
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| 6.  <a href="#">Ramsey County Public Library</a><br>Shoreview, MN 55126 United States         |   <a href="#">Book</a> | 26 miles<br><a href="#">MAP IT</a> |  <a href="#">Library info</a><br> <a href="#">Add to favorites</a>   |

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## Linked Data

### [More info about Linked Data](#)

#### Primary Entity

<<http://www.worldcat.org/oclc/214067440>> # Cabinology : a handbook to your private hideaway  
a [schema:Book](#), [schema:CreativeWork](#) ;  
library:oclcnum "214067440" ;  
library:placeOfPublication <[http://experiment.worldcat.org/entity/work/data/131592228#Place/newtown\\_ct](http://experiment.worldcat.org/entity/work/data/131592228#Place/newtown_ct)> ; # Newtown, CT  
library:placeOfPublication <<http://id.loc.gov/vocabulary/countries/ctu>> ;  
schema:about <<http://id.worldcat.org/fast/1001888>> ; # Log cabins--Design and construction  
schema:about <<http://dewey.info/class/690.873/e22/>> ;  
schema:about <[http://experiment.worldcat.org/entity/work/data/131592228#Topic/vacation\\_homes\\_design\\_and\\_construction](http://experiment.worldcat.org/entity/work/data/131592228#Topic/vacation_homes_design_and_construction)> ;  
# Vacation homes--Design and construction  
schema:about <<http://id.worldcat.org/fast/1204155>> ; # United States.  
schema:about <<http://id.worldcat.org/fast/1163507>> ; # Vacation homes--Design and construction  
schema:about <<http://id.loc.gov/authorities/subjects/sh2008107109>> ; # Log cabins--Design and construction  
schema:about <<http://id.worldcat.org/fast/1163505>> ; # Vacation homes  
schema:about <<http://id.worldcat.org/fast/1001885>> ; # Log cabins  
schema:about  
<[http://experiment.worldcat.org/entity/work/data/131592228#Topic/vacation\\_homes\\_united\\_states\\_design\\_and\\_construction](http://experiment.worldcat.org/entity/work/data/131592228#Topic/vacation_homes_united_states_design_and_construction)> ; #  
Vacation homes--United States--Design and construction  
schema:bookFormat [bgn:PrintBook](#) ;  
schema:copyrightYear "2008" ;  
schema:creator <<http://viaf.org/viaf/8563016>> ; # Dale Mulfinger  
schema:datePublished "2008" ;  
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schema:exampleOfWork <<http://worldcat.org/entity/work/id/131592228>> ;  
schema:genre "Designs and plans"@en ;

# LIS opportunity 5

- Integrate heterogeneous data by creating a canonical model, and carrying the source keys as attributes



# DOCUMENTS & CONTENT MGMT INFORMED BY DIGITAL LIBRARIES AND SEMANTIC WEB

# Urgent matter

- Document and Content Management is viewed as a critical strategic effort by DMBOK, because it is estimated that 80% of all stored data is maintained outside relational databases

# What is a digital library?

- A digital library can be simply defined as a collection of information which is both digitized and organized
- Concepts associated with digital libraries, predominantly information retrieval and information organization, have overlap with the concerns of Document and Content Management

# Digital libraries

- Practices and principles associated with Digital Libraries especially in the area of metadata should be explored because of metadata:
  1. Describes information resource content
  2. Provides searching capability
- The larger and more complex the domain, the greater the need for information organization skill sets to organize, build, and maintain the repository

# Other concepts

- Similar to application development, explore the use of digital library open source software for content management
- Explore concepts of Semantic Web, where the traditional Web is enhanced with formal knowledge placed below the current information through use of metadata and computational reasoning



# LIS opportunity 6

- Apply digital library concepts to document and content management, especially in the area of metadata
- Consider open source software and Semantic Web concepts for document and content management



# REFERENCE & MASTER DATA INFORMED BY VOCABULARIES, AUTHORITY FILES, AND THESAURI

# What is a CV?

- A controlled vocabulary (CV) is a specific list of terms for a specialized purpose. It is controlled because only terms from the list may be used for the subject area covered
- A taxonomy is a collection of controlled vocabulary terms organized into a hierarchical structure with parent-child relationships

# Benefit of CVs

- Provide a standardized list of terms used to tag data and information
- Provide a shared, commonly understood language to enable communication and knowledge exchange among stakeholders

# The heart of requirements: FRAD

- Functional Requirements for Authority Data (FRAD) serves these user tasks:
  - **Find** (find an entity through stated criteria)
  - **Identify** (confirm the entity corresponds to entity sought)
  - **Contextualize** (clarify a relationship in context)
  - **Justify** (document the authority data creator's reasoning)

# Application of CV

- The best practices of authority model implementation in libraries (including the steps involved in controlled vocabulary and taxonomy development and management) and the concepts associated with FRAD can inform reference and master data management

[The Library of Congress](#)>> [Go to Library of Congress Online Catalog](#)

# LIBRARY OF CONGRESS AUTHORITIES

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SOURCE OF HEADINGS: Library of Congress Online Catalog

## Authority Headings Search

Search Text:

Search Type:

Subject Authority Headings  
Name Authority Headings  
Title Authority Headings  
Name/Title Authority Headings  
Keyword Authorities (All)

Scroll down for  
Search Hints

100 records per page ▼

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## Authorities Search Tips

| Search Type    | Brief Help (select a search type for detailed Help)  |
|----------------|--|
| <u>Subject</u> | <ul style="list-style-type: none"><li>- Searches are "left-anchored" (<i>enter search starting with leftmost word</i>)</li><li>- Truncation is automatic</li><li>- Searches LC Subject Headings and Annotated Card Program (AC) Headings</li><li>- Searches LC Genre/Form Thesaurus, Thesaurus for Graphic Materials, etc.</li><li>- Searches other subject systems (e.g., Medical subject headings)</li></ul> <p><i>Examples:</i><br/>united states history civil war 1861 1865 regimental histories<br/>bible criticism interpretation etc</p> |

# VIAF

Virtual International Authority File

## Search

Select Field:

All Headings

Select Index:

All VIAF

Search Terms:

Search

## VIAF: The Virtual International Authority File

The VIAF® (Virtual International Authority File) combines multiple name authority files into a single OCLC-hosted name authority service. The goal of the service is to lower the cost and increase the utility of library authority files by matching and linking widely-used authority files and making that information available on the Web.





# LIS opportunity 7

- Apply the practices of controlled vocabulary development to reference data management
- Apply the FRAD user tasks of Find, Identify, Contextualize, and Justify as requirements for reference and master data management



# DATA WAREHOUSING & BUSINESS INTELLIGENCE INFORMED BY INFORMATION RETRIEVAL

# What is Information Retrieval?

- An information retrieval (IR) system's purpose is to make the right information available to the right user by collecting and organizing information in one or more subject areas and to provide information access to users on demand
- IR systems and BI-DWH systems are very similar in that both are leveraged to organize information and to seek answers to information needs

# IR system effectiveness

- Evaluation measures an IR systems by determining how well the system satisfies its objectives, how efficiently it satisfies its objectives, and whether the system justifies its existence
- Two basic parameters measure the performance of an IR system:
  - Effectiveness: determines the level up to which the system achieves its stated objectives
  - Efficiency: determines how economically the system achieves its objectives

# IR system evaluation approaches

- System-centered approach involves study of some aspect of performance by assessing effectiveness and/or efficiency of some feature or some specific design technological component
- User-centered approach involves study of behavior in respect to information needs, such as information seeking, browsing, searching or performance in completion of given tasks, either predetermined or observed in natural settings
  - Relevance criteria measure recall and precision, and utility criteria measure the degree of usefulness and user satisfaction

# BI-DWH evaluation

- BI-DWH systems have been evaluated (if at all) from the testing perspective for query result set correctness and query performance
- Opportunity: broaden the evaluation to include the user information seeking perspective
  - **Content** (availability, clarity, informativeness, adequacy, quality, validity, authority)
  - **Process** (learnability, effort, convenience, completion, sureness in results)
  - **Format** (attractiveness, consistency, communicativeness of messages)
  - **Overall assessment** (satisfaction, success, relevance, usefulness, impact, preferences, learning)

# LIS opportunity 8

- Evaluate BI-DWH systems by system-centered and user-centered measures



# META-DATA MANAGEMENT INFORMED BY METADATA



# What is Metadata?

- In the library and information science domain, metadata is defined exactly the same as “data about data”
  - The term *meta* is defined as “*occurring later than or in succession to*”
  - Metadata is constructed information of human invention and not found in nature and is used a surrogate for the real thing

# LIS Metadata

- In the digital environment, the surrogate role of metadata is key because many resources are not easily browsable and others do not carry clear data about themselves
  - Similar problem in information management context: the data does not usually carry descriptive data about itself
- Metadata is a constructed surrogate that allows users to gain context about the data by describing various aspects about it that are not inherent in it

# Metadata evaluation

- Idea: use the FRBR user tasks of **Find**, **Identify**, **Select**, and **Obtain** to measure metadata effectiveness
- Justification: make the business case for meta-data management by working with stakeholders to envision:
  - shopping in a grocery store that has food products without labels and aisles without signs
  - a library without shelves or a catalog

# LIS opportunity 9

- Conceptualize metadata as a constructed surrogate
- Use the FRBR tasks of Find, Identify, Select, and Obtain as a framework for metadata effectiveness evaluation



# DATA QUALITY MANAGEMENT INFORMED BY METADATA QUALITY

# What is Metadata quality?

- Similar to data in general, metadata has inherent quality measured by its accuracy, and pragmatic quality measured by its degree of usefulness to consumers
  - Measures include accuracy, completeness, and consistency
- Of special concern in metadata quality definition and measurement criteria is interoperability
  - Shareable metadata should be “useful and usable” to services outside of its local context

# Metadata quality

- Evaluation and assessment of metadata is important in determining its quality
- Define requirements for the local and global contexts
- Management should prioritize data quality not as a one-time effort, but as an ongoing process of continuous improvement and should commit the necessary financial and human resources to achieve

# LIS opportunity 10

- Document data quality requirements from the local and global contexts
- Provide funding and resources to measure and address data quality





# DATA GOVERNANCE INFORMED BY INFORMATION GOVERNANCE AND STANDARDIZATION

# What is Information Governance?

- IG guides corporate record decisions
  - Several areas such as Records Management, Information Security, IT Risk and Compliance, eDiscovery, Business Continuity need to interact and collaborate
- Library standards guide e-resource management
- Develop objectives which have a measure, a standard, and a timeframe
  - measure progress realistically and evolve over time

# LIS opportunity 11

- Identify the roles that must work together in data governance
- Identify standards that relate to data governance
- Recognize that data governance is evolutionary



# ENVIRONMENTAL ELEMENTS

# People are key

- Our fascination with technology has made us forget the key purpose of information: to inform people
  - Information and knowledge are human creations, and we will never be good at managing them unless we give people a primary role

# Mandatory for funding

- What if a mindset barrier was removed and effective data management was mandated rather than encouraged or wished for?
  - National Science Foundation announced that data management plans would be required for all grant applications starting in 2011

# LIS opportunity 12

- Emphasize the environmental elements aligned with People more than the elements aligned with Process and Technology
- Mandate an overall information and data management strategy in order to receive funding



# SUMMARY



# Summary of opportunities

| Knowledge Area                      | Interdisciplinary Lesson   |
|-------------------------------------|--|
| Data Architecture                   | <ul style="list-style-type: none"> <li>• Apply the principles of information architecture to overall data architecture</li> <li>• Apply the FRBR user tasks of Find, Identify, Select, and Obtain as requirements for data architecture</li> </ul>               |
| Data Modeling & Design              | <ul style="list-style-type: none"> <li>• Help users to locate, evaluate, and effectively use data models and metadata</li> <li>• Use simple tools to communicate and share data models</li> </ul>  |
| Data Storage & Operations           | <ul style="list-style-type: none"> <li>• Explore the use of cloud technologies for data storage and services</li> </ul>  |
| Data Security                       | <ul style="list-style-type: none"> <li>• Develop well-defined policies for information security and data privacy</li> <li>• Provide ethics training in academic and workplace settings</li> </ul>  |
| Data Integration & Interoperability | <ul style="list-style-type: none"> <li>• Integrate heterogeneous data by creating a canonical model, and carrying the source keys as attributes</li> </ul>   |
| Document & Content Management       | <ul style="list-style-type: none"> <li>• Apply digital library concepts to document and content management, especially in the area of metadata</li> <li>• Consider open source software and Semantic Web concepts for document and content management</li> </ul> |

# Summary of opportunities

| Knowledge Area                           | Interdisciplinary Lesson   |
|--|--|
| Reference & Master Data Management       | <ul style="list-style-type: none"><li>• Apply the practices of controlled vocabulary development to reference data management</li><li>• Apply the FRAD user tasks of Find, Identify, Contextualize, and Justify as requirements for reference and master data management</li></ul> |
| Data Warehousing & Business Intelligence | <ul style="list-style-type: none"><li>• Evaluate BI-DWH systems by system-centered and user-centered measures</li></ul>  |
| Meta-data Management                     | <ul style="list-style-type: none"><li>• Conceptualize metadata as a constructed surrogate</li><li>• Use the FRBR tasks of Find, Identify, Select, and Obtain as a framework for metadata effectiveness evaluation</li></ul>  |
| Data Quality Management                  | <ul style="list-style-type: none"><li>• Document data quality requirements from the local and global contexts</li><li>• Provide funding and resources to measure and address data quality</li></ul>  |
| Data Governance                          | <ul style="list-style-type: none"><li>• Identify the roles that must work together in data governance</li><li>• Identify standards that relate to data governance</li><li>• Recognize that data governance is evolutionary</li></ul>   |

# Summary of opportunities

| Knowledge Area         | Interdisciplinary Lesson  |
|------------------------|---|
| Environmental Elements | <ul style="list-style-type: none"><li>• Emphasize the environmental elements aligned with People more than the elements aligned with Process and Technology</li><li>• Mandate an overall information and data management strategy in order to receive funding</li></ul> |

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  - My paper is available upon request at [vonfruke@msn.com](mailto:vonfruke@msn.com)
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