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Linked Data in Libraries: Library of Congress' Bibliographic Framework Transition Initiative

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LIBR 281: Metadata

**Abstract:**

This research paper examines Library of Congress' Bibliographic Framework Transition Initiative, or BIBFRAME, through the lens of current Library and Information Science literature on introducing Linked Data principles into cataloging. This research paper aims to find whether BIBFRAME fulfills expectations of Linked Data based cataloging as well as whether BIBFRAME shows promise in overcoming drawbacks to MARC-based cataloging as expressed in the literature.

## Introduction

As the Semantic Web becomes increasingly ubiquitous, librarians have examined their role in the new information landscape. What are the ways in which the Semantic Web can benefit libraries and library services, and what are the ways in which libraries can enhance information on the Web? How will web-based information change the way that libraries store, retrieve, and use information? How will these changes affect current cataloging systems?

One of the emergent concepts from the Semantic Web is that of Linked Data. Linked Data, or Linked Open Data, is a “best practices approach” of publishing data on the web that allows related information to be connected through hyperlinks (Berners-Lee, 2009b). While Linked Data is still a relatively new concept (Tim Berners-Lee, creator of the Web, gave a TED Talk called “The Next Web” outlining Linked Data concepts in 2009) some within the Library and Information Science field have advocated for adopting a Linked Data approach to cataloging.

Current research in the Library and Information Science field has explored some of the benefits towards adopting Linked Data principles, as well as the potential challenges in making a paradigm shift. In May of 2011, the Library of Congress announced the undertaking of their Bibliographic Framework Transition Initiative (Library of Congress, 2011). Called BIBFRAME, this initiative would provide a road map for transitioning from the MARC-based catalogs (MARC stands for Machine-Readable Cataloging) towards a system founded on Linked Data principles, integrating library catalog information with the World Wide Web. The Library of Congress' goal for BIBFRAME is that it will serve as:

[T]he foundation for the future of bibliographic description that happens on the web and in the networked world. It is designed to integrate with and engage in the wider

information community and still serve the very specific needs of libraries (Library of Congress, 2013b)

The Library of Congress acknowledges that information is not solely within the realms of libraries and librarians- information is moving onto the Web, and people are looking for information on the Web.

This research paper explores whether the Bibliographic Framework Transition Initiative meets the needs expressed in the Library and Information Science literature, particularly in how it has faced the challenges outlined in moving away from MARC-based cataloging, and whether it has fulfilled the expected benefits that Linked Data seems to promise.

### **Linked Data: What is it?**

It is firstly important to understand Linked Data before delving into its potential for cataloging. Linked Data (LD) is a “best practices approach” for those who publish data on the web (“Linked Data”, nd). Simply put, Linked Data allows related information to be connected on the web environment. Linked Data is the brainchild of Tim Berners-Lee, creator of the World Wide Web and director of the World Wide Web Consortium (W3C) (“Tim Berners-Lee”, 2013). Linked Data differs from traditional Web publication in that it aims to describe data, not documents. This is accomplished using unique identifiers for people, places, ideas, or anything else called “Uniform Resource Identifiers” or URIs (Berners-Lee, 2009b). Specifically, authors would use HTTP URIs, which link users to additional information about the person, place, or idea. Additional principles set forth by Berners-Lee (2009b) include providing useful information, abiding by current standards, and linking to other data points using URIs. Following these practices, a person can follow links to find useful information, regardless of whether it is the same as the general topic of a document, or mostly tangential.

One of the advancements from the original concepts of Linked Data is now the concept of Linked Open Data, which can be considered Linked Data that is published under open license and using non-proprietary formats (Breeding, 2012). Both Linked Data and Linked Open Data have the same goal: bringing related information together, and increasing access to information.

One potential barrier to accessing information across different libraries and cultural heritage organizations that proponents of Linked Data hopes to overcome is the phenomenon of “information silos”, or large stores of information that have no way of interconnecting to share, connect, or transfer information. Linked Data standards work to lower those barriers and prevent information silos from forming on a Web environment; and has such piqued the interest of those within the Library and Information Science field as well as the traditional Computer Science and Information Technology communities that are often associated with the World Wide Web.

## **Literature Review**

As the Library and Information Science community has begun to explore Linked Data, research has progressed along the following concentrations: drawbacks of the current MARC-based cataloging system, the benefits of adopting Linked Data principles, the potential challenges of implementing Linked Data, and recommendations for going towards linked data.

### **Drawbacks of MARC-based Cataloging.**

Library catalogs enable users to find items in a library's collection, and this is accomplished by metadata. Metadata, while literally meaning “data about data” can be defined as “structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource” (NISO, 2004). In electronic library catalogs, the most ubiquitous method of structuring that information is MARC, or Machine-Readable Cataloging. From the Library of Congress, MARC “provides the mechanism by which

computers exchange, use, and interpret bibliographic information, and its data elements make up the foundation of most library catalogs used today” (Library of Congress, 2006).

MARC was developed in the late 1960s, and while it has undergone changes since then, it is still widely used today. While this provides a great store of MARC-based records in existence (Alemu et al (2012) estimate there are over a billion MARC-based records in existence today) it also means many of these records exist according to information standards that were necessary when information storage technology was not as advanced. According to Breeding (2013), MARC was developed to reduce the amount of storage needed to communicate the same amount of information.

In addition to specifying a format for information, bibliographic standards have developed to ensure accuracy and consistency across records regardless of location or person creating the records. Yet, despite these standards, inconsistencies in records still persist. Unintentional errors, blank fields, or localized practices may make collections quite different from each other (Schreur, 2012). These errors may be easily reconciled to a person viewing records, but a computer program retrieving these records will not always catch or correct these errors.

Another aspect of MARC-based cataloging is that it is document-centric; that is, whole works (or documents) are described and this information is organized at the document level (Alemu, Stevens, Ross, & Chandler, 2012). This means that metadata is focused on and centered around whole works (or documents). Documents are described using metadata elements such as title, author, and subject. When searching books or articles that contain specific information, one relies that the subject metadata (as well as all other fields) is accurate and complete. The

creation and maintenance of these bibliographic records requires a considerable amount of resources of staff, time, and money (Schreur, 2012).

Similarly, the World Wide Web has been document-centric in its organization: people publish web pages (documents) that are easily understood by people but do not carry semantic meaning embedded in the HTML, so that these documents are not machine-readable (Alemu et al, 2012). Related information is not easily linked, because search engines and other web applications are unable to “read” the web as people. LOD aims to make information on the Web machine readable and linkable. As the Web grows in this way, the library can grow with it, linking to it, and having Web searches direct back to the library.

### **Benefits of Linked Data**

Much of the current literature on Linked Open Data and libraries aims to describe the various benefits of libraries adopting LOD in their catalogs. These benefits include sharing metadata, facilitating linking outside the catalog, increased visibility in the information landscape, and increased findability and discoverability.

The first benefit of adopting a linked open data approach is the sharing of metadata. As previously mentioned by Schreur (2012), creating and maintaining bibliographic records requires resources in the form of staff, time, and money. LOD allows libraries to reuse data created by others in their bibliographic records, whether this is provided by the vendors themselves or created by other libraries or information institutions (Borst, Fingerle, Neubert, & Seiler, 2010). This sharing of data will encourage collaboration across libraries and decrease resources spent creating and maintaining bibliographic records, freeing these resources to be used in other ways.

In addition to encouraging sharing of metadata and bibliographic records across libraries and catalogs, LOD will facilitate linking cataloged information with data from outside the



catalog (Alemu et al, 2012), creating an open system. Traditional library catalogs are closed systems, meaning that in order to find information it has to exist within that system (Schreur, 2012). Linked Open Data is an inherently open system. A library patron searching for information not contained within the traditional catalog is no longer bound by the traditional closed catalog system. Information in the catalog is now linked with information from other libraries, archives, and cultural heritage organizations.

Schreur (2012) describes how the National Library of France (Bibliothèque nationale de France, or BnF) uses RDF (Resource Description Framework, a metadata scheme that underlies much of LOD and the Semantic Web) to enhance their users search experience. One may start off from selecting Edgar Allen Poe from their list of authors, and can explore different formats for the poem, *The Raven*; find a picture of the Poe family headstone, or view a video recording of a lecture on Poe (Schreur, 2012). All of these come from different museums, libraries, or organizations; all are available through an open and linked system.

Another benefit of participating in Linked Open Data is that it allows libraries and other institutions to remain visible among the increase in options available to meet a searcher's information needs (Solodovnik, 2013). Zengenene (2013) states, "Never before has the role of libraries in the information society been challenged as today. The entire political, social and economic landscape for which libraries have been part of has changed and is in a process of change" (p. 85). As there continue to be more and more options available to find information and more users are looking online to meet their information needs (Keller, Persons, Glaser, & Calter, 2011; Schreur, 2012), libraries are at risk of fading into the background. By using LOD principles and linking information within library systems to outside information, libraries will remain a visible and active resource for information seekers.

This isn't just to benefit libraries themselves. Staying visible on the web and taking advantage of LOD possibilities will allow libraries to offer more dynamic and unique services (Borst et al, 2010). Here we see the mutual benefit of libraries and the Semantic Web: as libraries link their stores of information with those available through the web libraries can offer enhanced search features for their users, and in doing so, libraries add to the richness of the web itself.

The most frequently cited benefit to libraries adopting a Linked Open Data approach is increased findability and discoverability. Alemu et al (2012) refers to this as the "serendipitous discovery of information resources" (p. 557), Solodovnik (2013) refers to enhanced "description and discovery" (p. 135), Schreur (2012) writes that it allows libraries to "expand their discoverability" (p. 232), and Maddux & Johnson (2012) write the Semantic Web leads to "data integration" (p. 3). Regardless of the phrasing used, it seems everyone agrees that Linked Data not only brings the user what they are searching for (findability), it also helps connect them to what they didn't know they were looking for (discoverability).

Benefits of Linked Open Data for libraries are clear: Linked Open Data will allow for reuse of metadata, decreasing the amount of resources required to maintain catalog records; Linked Open Data will open up the catalog and prevent information silos from developing; Linked Open Data will facilitate discovery on behalf of the user.

### **Potential Challenges.**

While so many people agree on the benefits to Linked Open Data, it is not to say that implementing Linked Open Data in the catalog is without its challenges as well. Since LOD will fundamentally change the way library records are created, published, and maintained, there will be obstacles. Current and anticipated roadblocks include the lack of awareness, knowledge, and

success stories; extensive use MARC requiring a considerable amount of resources to replace, complexity of technology, and non-available vocabularies. Also discussed are the obstacles in navigating the legalities around publishing open data, which will not be addressed in this paper.

While concepts of the Semantic Web have been around since the invention of the Web, Linked Open Data is still a very recent development (Alemu et al, 2012). Chudnov (2011) and Zengenene (2013) both acknowledge that not yet everyone is familiar with LOD and its potential for libraries. For those libraries and librarians who are familiar with LOD, there still exists trepidation. MARC format is ubiquitous, and represents countless resources that have been invested in its creation and maintenance. As there is still a dearth of success stories around LOD (Chudnov, 2011) it is unsurprising that libraries are hesitant to adopt a new format, with all of the initial work that would go into its creation.

Once a library has decided that it is willing to invest time, money, and staff towards creating LOD, or moving in that direction, there exists some practical obstacles as well. Schreur (2012) writes that one of the challenges in LOD is what he terms subject access, or accurately representing the “aboutness” of a work. Mendez & Greenberg (2012) report that the majority of searches completed online relate to aboutness. Being able to accurately represent aboutness in a way that is meaningful will be important implementing LOD successfully. While there has been movement towards publishing Linked Open Vocabularies (Mendez & Greenberg, 2012) to benefit the wider library community, current vocabularies are by no means exhaustive.

### **Recommendations.**

Another aspect of Linked Open Data literature are the practical steps libraries can take to moved towards an LOD system. Strategies put forth include incorporating principles of Linked Open Data within current bibliographic frameworks, from the creation and maintenance of

bibliographic records to the online presence of a library. Publishing data for others and using data already published, encouraging vendors to move towards LOD, and using good metadata are additional recommendations.

In 2011, Stanford University hosted a weeklong workshop for librarians and technologists focusing on Linked Open Data (Keller et al, 2011). One of the fruits of this workshop was a manifesto that provides a snapshot into the overall mindset and tangible actions that promote Linked Open Data. The core of the "Manifesto for Linked Libraries (and Museums and Archives and...)" (2011), recommends specific practices: publishing data where people are looking for it (on the Web); publishing and improving data and Linked Data, using semantic web standards to publish structured data, adhering to the Web standards, and publish information with open licenses (p. 22). These recommendations are practical and can be accomplished without overhauling an entire bibliographic system.

In regards to the Manifesto's first recommendation (publishing data on the web), there are multiple ways this can be accomplished and Chudnov (2011) puts forth several recommendations for web publishing that will be beneficial for the library. This includes using consistent URLs and linking back to your own data, as well as data across the web. These steps will allow search engines and users to easily find your library out of the multitude of options online. Chudnov (2011) states that if there exists a user of your library searching for information on the web that is available through your library, that user should be directed to the library (p. 36). Consistent URLs and increased links will allow this to happen.

Publishing data online is the first step; next comes improving on data and Linked Data. The Stanford Manifesto acknowledges that waiting to publish "perfect" data will inhibit the growth of Linked Open Data, however data and metadata should be published with some

standards. Solodovnik (2013) outlines the National Information Standards Organization (NISO) principles of “good” metadata, which includes adhering to community standards, supporting interoperability, using authority control and content standards, clearly communicating terms of use, supporting preservation, and as objects themselves be considered to be uniquely identified and with authority, authenticity, and ability to be preserved (Solodovnik, 2013). Any organization working towards a Linked Open Data information system will need to balance creating “good metadata” according to the NISO standards but also publishing information in a timely manner, even if it is still a work in progress, in order to facilitate growth.

### **Methods**

This research paper takes a qualitative approach. I reviewed recent articles published in the field of Library and Information Science that address benefits, challenges, and recommendations for adopting Linked Data in library cataloging. I then analyzed documents published by Library of Congress/BIBFRAME, but not reviews of such. Went with primary documents only. Next, I created a BIBFRAME timeline, as the Library of Congress' BIBFRAME page is organized according to resources, announcements, and reports, but I found it helpful to have a chronological snapshot of BIBFRAME events. I used content analysis on published articles on BIBFRAME.org, and examined the ways in which BIBFRAME's published documents addresses or responds to the points in the LIS literature.

### **Data Analysis & Discussion**

The question to be answered is “In what ways does BIBFRAME respond, directly or indirectly, to current literature published in the Library and Information Science field? Does it fulfill the expectations of a Linked Open Data system? Does it address the shortcomings of

MARC and does it follow recommendations outlined in the literature?”. This paper aims to answer these questions by exploring the literature and BIBFRAME documents.

As outlined in the literature review, the drawbacks of the current MARC-based catalogs include being document-centric as opposed to data-centric, does not effectively link related information and can create information silos, require large resources to create and maintain, and include inconsistencies across organizations. Advantages of a Linked Open Data catalog include shared metadata, facilitate linking outside the catalog, increased visibility in the information landscape, improved findability and discoverability. The drawbacks of the old system and the promise of a new system naturally find complementary themes, and so I will be discussing these together. First I will provide a quick overview of BIBFRAME's history.

#### **Timeline of BIBFRAME since its inception.**

Library of Congress announced their Bibliographic Framework Initiative in May of 2011 (Library of Congress, 2011b). A statement released on May 13, 2011 discussed the need to develop new technology to address the metadata needs of the library and cultural heritage community, and simultaneously acknowledged the decrease in funding these organizations have been receiving. This statement announces the initiative will “analyze the present and future environment, identify the components of the framework to support our users, and plan for the evolution from our present framework to the future” (Library of Congress, 2011b). This initial statement was not designed to provide detailed information about the initiative, but rather announce the initiative to the Library and Information Science community.

Five months later, the Library of Congress released their initial plan that addressed goals, approach, and investigations of the project in a document entitled “A Bibliographic Framework for the Digital Age” (2011a); this document included a cover from Deanna Marcum, Associate

Librarian, as well as a more detailed "General Plan". The cover document recommended two separate groups would be most beneficial to the initiative: an advisory committee that will focus on the conceptual aspects and a technical committee that will apply those concepts and create the framework (Library of Congress, 2011a). Additionally, the cover document acknowledged the Library of Congress' commitment to support MARC (Machine-Readable Cataloging) formats during and after the transition. The general plan for the framework included eight requirements that the new framework will need to accommodate. These requirements include supporting a range of data models, the ability to include data that often accompanies bibliographic data (e.g., holdings), capability of supporting both text and linked data, accommodate the needs of all libraries regardless of size or focus, be compatible with MARC, and allow for the transformation of MARC data into the new framework. The General Plan also explored some of the other developments regarding XML (a language for encoding information in Web documents) and metadata schemes. Similar to the initial announcement, the purpose of this document was not to set forth all of the steps that the BIBFRAME initiative would take, but to show what progress had been completed in the first few months of the project. This document is aiming to show the Library and Information Community that the initiative does not mean abandoning their current bibliographic information and to present an overview of what the new format may include.

The BIBFRAME Initiative continued making progress and releasing new information in the year 2012. In January of 2012 the Library of Congress presented at the American Library Associations midwinter meeting, giving an "Update Forum" that both provided information on BIBFRAME progress and took questions from the audience (Library of Congress, 2012a). In May 2012 they announced contracting with Zepheira (Library of Congress, 2012c), a company that "helps organizations use the Web to connect, visualize, analyze and augment data assets

across system boundaries. We employ expertise in semantic Web standards, linked data principles, Web architecture and social engineering to solve information management problems” (“Zepheira”, 2013). This contract led the Library of Congress to publish their introductory BIBFRAME model in November of 2012 (Library of Congress, 2012b). The model was described in “Bibliographic Framework as a Web of Data: Linked Data Model and Supporting Services” (Library of Congress, 2012b), and included four main classes of information: Creative Work, Instance, Authority, and Annotations. The primer defines these classes and provides graphic representations of the relationships between classes. The primer also provides an introduction to Linked Data concepts and a review of similar projects and initiatives (Library of Congress, 2012b). This introductory model is important as the ground level upon which the rest of BIBFRAME will be built.

The year 2013, while not yet finished, as also included significant goalposts for BIBFRAME. As of January 2013, a separate website for BIBFRAME (previously housed only on the greater Library of Congress site, at [www.loc.gov/bibframe](http://www.loc.gov/bibframe)) went live at [www.bibframe.org](http://www.bibframe.org). In addition to providing all published documents on BIBFRAME, the website also has tools and demonstrations of converting MARC-based records, online tools, and vocabularies. Additionally, The Library of Congress released discussion papers for Resource Types, Authority, and Annotations, one a month between April and June (Library of Congress, 2013a,c-d). In the two years since Library of Congress had announced their initiative, they have shown steady and consistent progress.

### **Document vs. Data-Centric Description Models and Linking Outside the Catalog.**

Drawbacks of MARC-based records are the document centric approach and the inability of linking outside the traditional catalog. The Bibliographic Framework Transition Initiative



thoroughly responds to these first two concepts. In the cover page for the document “Bibliographic Framework for the Digital Age” (Library of Congress, 2011a), Marcum quotes the “Working Group of the Future of Bibliographic Control” as stating that MARC is “out of step with the programming styles of today”, hence the aim of creating a new model and transition framework. The approach outlined in “Bibliographic Framework Initiative General Plan” (Library of Congress, 2011a) states the initiative will be “focused on the Web environment, Linked Data principles and mechanisms, and the Resource Description Framework (RDF) as a basic data model”. Using Linked Data principles (URIs, linking to other information) and RDF (a computer language that underpins much of the Semantic Web) addresses the shortcomings of by allowing for data-level description and linking outside the traditional catalog. In fact, an entire class of BIBFRAME is dedicated to facilitate the linking of information outside the catalog. Annotations, as BIBFRAME refers to this group of information, may include reviews, biographical information of the creators or contributors; cover art, or description from the publisher (Library of Congress, 2013a). By including these options from the ground level, BIBFRAME demonstrates that it will include the feature of linking outside the traditional catalog.

#### **Creation and Maintenance of Records, Sharing Metadata.**

Another current drawback of MARC-based catalogs is the amount of resources required to create and maintain accurate records. BIBFRAME documentation does not address this directly. The Library of Congress does acknowledge that creating a new framework will require immense resources (2011a), but does not directly discuss the amount of resources needed to maintain these records once BIBFRAME is developed. It is quite possible that it is simply too difficult to estimate how much time, how much staff, or how much money will be needed.

One of the advantages to Linked Open Data is the sharing of metadata. BIBFRAME.org has a page for Vocabulary that has over 200 Uniform Resource Identifier (URI) listed under Vocabulary Updates. An example vocabulary document is “Nonmusical Audio” (found at <http://bibframe.org/vocab/NonmusicalAudio>), which is defined as “Resources expressed in an audible format that is not musical” (“Nonmusical Audio”, 2013). This entry includes a modification history and a table including information for Property, Label, and MARC Mapping. On the BIBFRAME “Tools” page (2013), they offer both comparison and transformation services to view and download MARC records translated into the BIBFRAME model. While BIBFRAME is not yet being implemented in library catalogs, they are already adopting an open and shared approach that will likely transition into continued sharing of metadata. Hopefully, this open and shared model will reduce the number of inconsistencies across different organizations as well.

### **Increased Visibility in the Information Landscape**

Several authors have noted that Linked Data is not yet a household term for all in the Library and Information Science field. Library of Congress has shown efforts towards increasing awareness of BIBFRAME specifically and Linked Data more generally. They have included background information on Linked Open Data in their Primer (Library of Congress, 2012b) and include this information on their website. In the document “Bibliographic Framework as a Web of Data”, authors note that BIBFRAME aims to balance both “social and technical adoption outside the Library community”, as well as “social and technical deployment within the Library community” (Library of Congress, 2012b, p.8). This statement, while brief, acknowledges that while the immediate benefit may be to the library catalog and for the greater Library and Information Science community, linked data is now an enterprise that benefits not

just the greater Semantic Web or Computer Science communities, but everyone who uses and publishes data on the Web. Additionally, The Library of Congress had an "Update Forum" presentation at the American Library Association's midwinter meeting in January of 2012. At this presentation they provided current progress and answered questions from attendants. In this way, they are taking steps to increase awareness of Linked Data and BIBFRAME.

Another way that BIBFRAME brings the Library and Information Science field into the greater information landscape is through their contract with Zepheira. The co-founder and president of Zepheira, Eric Miller, was previously the leader of the World Wide Web Consortium's Semantic Web Initiative ("Eric Miller", 2013).. By contracting with Zepheira, a company that was not previously library-focused, BIBFRAME enters into the greater Semantic Web community.

#### **Improved Discoverability and Findability.**

While this happens to be the most talked about benefit in the literature regarding Linked Open Data's benefit to library catalogs, it seemed to be the least discussed in the BIBFRAME literature. "Bibliographic Framework as a Web of Data" includes background information on Linked Open Data, and includes the benefit of enhanced discoverability in a web environment. "LOD means making it easier for people to discover important things you place on the Web, and making it easier for them to do unexpected, fruitful things with them" (Library of Congress, 2012b, p. 27). While they acknowledge the benefit of increasing discoverability, and that LOD improves discoverability on the Web, the BIBFRAME Primer does not directly address ways in which adopting the BIBFRAME model will assist in discoverability in the library. Perhaps the reader is meant to draw that conclusion: Linked Open Data leads to increased discoverability of

information on the Web, it will naturally accomplish the same once Linked Open Data is incorporated into the Library catalog.

### **Conclusion**

The Bibliographic Framework Transition Initiative is still a very new project launched by the Library of Congress. This Initiative has shown steady and consistent progress with the release of an introductory model and discussion papers on three of the four main classes. The BIBFRAME Initiative responds specifically to some criticisms of MARC-based cataloging, such as inability to link outside the traditional catalog. BIBFRAME has also shown some of the promise of a Linked Data catalog, such as increased visibility with the greater information landscape and sharing of metadata. While it does address several shortcomings of traditional cataloging, as well as fulfill some of the expectations of Linked Open Data in library catalogs, it still has a long way to go in “fleshing out” many of the ideas. However, BIBFRAME has clearly defined goals, has produced an impressive amount of literature in the past 2 years, and is continuing to move forward along that journey.

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