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Assessing the Readiness for and Knowledge of BIBFRAME in Canadian Libraries

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ABSTRACT

This study assesses the Canadian library community's understanding of and readiness for the transition from the MARC format to the BIBFRAME model. Results indicate that knowledge of BIBFRAME is low among respondents and that most of the libraries surveyed do not know enough about BIBFRAME to consider planning a transition. The success of the transition will depend on the leadership of larger libraries as well as better training in formal programs and continuing education initiatives.

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Introduction

“Linked data is not some far off aspiration,” Folsom postulates, “it’s happening now.”¹ Yet, most libraries still rely on the 1960s-era MARC format to describe items in their online catalogs, a format that is not well understood outside of the library community. To make library data more broadly useful, librarians need to transition catalogs away from string literals and *one record for one resource* to a structure that presents the relationships between discrete elements of resources represented through unique resource identifiers (URIs). Librarians need to restructure library data so it can engage and interconnect with other data on the Semantic Web.

To facilitate the transition away from the MARC format, the Library of Congress (LC) and the international library community developed the Bibliographic Framework (BIBFRAME) linked data vocabulary.² Libraries are increasingly adopting BIBFRAME. The Swedish National Library was the first national library to implement BIBFRAME in July 2018,³ and European BIBFRAME Workshops have been ongoing and supporting the community since 2017. Within North America, the most significant collaboration has been through the Linked Data for Production (LD4P) Mellon-funded series of grant projects which began in 2016. LD4P2:

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Pathways to Implementation, 2018–2020, included a cohort of 17 academic libraries (in addition to four institutions collaborating directly with LC) committed to transitioning their MARC-based workflows to linked data. In 2021, LC was nearing their goal of 80–90% cataloging exclusively in the BIBFRAME editor,⁴ and the Program for Cooperative Cataloging (PCC) stated their support for BIBFRAME as “a framework that better accommodates linking of data elements and has the potential for integration with [the] Semantic Web.”⁵ Although library linked data is broader than BIBFRAME, this is the direction libraries are being led by major collaborations spanning multiple countries.

For most libraries the transition from MARC to BIBFRAME will likely be similar in scope to libraries’ transition from card catalogs to computer catalogs. Starting in the 1980s and continuing into the 1990s, library retrospective conversion projects moved metadata from catalog cards to MARC records primarily as a one-way conversion.⁶ Early adopters of BIBFRAME, however, must ensure their metadata is “backward compatible” to MARC until a majority of libraries are cataloging and sharing metadata exclusively within BIBFRAME. To work toward a solution to this issue, the PCC hosted a BIBFRAME Data Exchange Meeting in September 2021 “to discuss exchange of BIBFRAME data between systems and implementations.”⁷ In April 2022 the PCC created terms of reference and sent out a call for participation on a BIBFRAME Interchange Group.⁸ Although many libraries around the world will continue to use MARC records and will not make the transition to BIBFRAME for some time, those libraries will nonetheless experience the effects of the BIBFRAME format within the records they import into their catalogs.

One prerequisite for the transition to BIBFRAME is the availability of library systems that can create, share, and search BIBFRAME linked data. LC has developed MARC to BIBFRAME and BIBFRAME to MARC converters to share records with other libraries and uses its BIBFRAME Editor for cataloging. The third phase of the LD4P collaboration, Closing the Loop: 2020–2022, aims to create a working model of a complete cycle for library metadata creation, sharing, and reuse with the Sinopia application as its linked data editing platform. In creating a bank of library linked data for use, the SHARE VDE project has converted roughly 100 million MARC records to BIBFRAME from LD4P2 institutions, the library community, and LC. The library world is approaching a tipping point at which it will be necessary for all librarians to be aware of, and have a basic understanding of, linked data and the implications of BIBFRAME adoption within libraries.

Most Canadian libraries will not directly participate in BIBFRAME system development, but once BIBFRAME-oriented systems are available,

individual institutions will need to decide when to move away from the MARC format. Library staff will need training to understand the basics of linked data and how to describe items using the BIBFRAME vocabulary, and workflows will need to be adjusted. Additionally, as a library becomes more “ready” for a transition, the desire for education and training will move from an interest in theoretical understanding to a need for practical, hands-on learning. Given that this sea change is happening, and that there is currently only one Canadian library among the increasing number moving to adopt BIBFRAME, the Canadian Federation of Library Associations Cataloging and Metadata Standards Committee established the Canadian BIBFRAME Readiness Task Force in Fall 2018. Part of the Task Force’s mandate was to determine the readiness for, and understanding of, BIBFRAME within Canadian libraries.

To get a baseline assessment of the Canadian library community’s readiness to transition from MARC to the BIBFRAME format, the researchers developed a survey to collect data from individuals at Canadian libraries regarding their understanding of linked data and BIBFRAME basics, as well as their consideration of their library’s readiness for an organizational change that would happen as part of BIBFRAME adoption. This paper describes the results of that survey and the three elements of awareness, organizational readiness, and understanding that arose from the survey results as major factors for a transition from MARC to the BIBFRAME format within the Canadian library community.

Literature review

Connecting library metadata with the Semantic Web

The crux of the argument for transitioning from MARC to BIBFRAME format is that MARC records and thus library metadata are siloed within the library world. Since the “dawn of linked data,”⁹ the Semantic Web of linked data has continued to grow, and each year increasingly overshadows library metadata as shown in the Linked Open Data Cloud.¹⁰ As pointed out by Casalini: “In a world that is ever more web-based, libraries risk marginalization if they cannot build links toward making their data more accessible; therefore, they must increase the discoverability of their resources.”¹¹ And as Steele succinctly sums up in his findings: “the user experience with the library catalog has changed and ... BIBFRAME is a first step in meeting the user needs of the future.”¹²

Although most library vocabularies and authority files are now available through linked data services such as that offered by LC,¹³ without a linked data structure to hold library metadata it will continue to be

inaccessible—almost invisible—to the larger Semantic Web. There is great promise in making library metadata more accessible, as Schreur noted:

conversion of our bibliographic records from MARC to linked data will become one of the most powerful drivers in the transformation to the Semantic Web, placing our data and resources where people are searching, and tying them intelligently to the wealth of the Web.¹⁴

The LC BIBFRAME FAQ describes “the BIBFRAME Model [as] the library community’s formal entry point for becoming part of a much larger web of data, where the links between things are paramount.”¹⁵ In her interview with Dull, Rebecca Guenther explains that “[...] in restructuring and transforming MARC, [BIBFRAME] will provide a mechanism to make previously created records available.”¹⁶ BIBFRAME provides the necessary structure to move MARC records out of the “library silo” to make them accessible within the Semantic Web.

Moving library metadata to the Semantic Web requires libraries to think differently about metadata than they have for the past 60 years in MARC. Dull notes that “BIBFRAME can also be thought of as a new way of thinking about how libraries package, reuse, and share the wealth of bibliographic descriptions developed through years of collaborative effort.”¹⁷ Rather than having one record per resource owned by a library, a library catalog working with linked data will provide a hub of connections for individual pieces of metadata pertaining to a particular resource, with some of those connections also linking to other resources within the library catalog and beyond. The “unit” of interest moves from the bibliographic record as a whole to the relationships between individual pieces of metadata within bibliographic records. The addition of URIs allows computers to identify individual pieces of metadata, including relationships. Then through a series of URI triple statements, computers are provided the information to connect individual pieces of metadata through their relationships. For example, by assigning a URI to each of the work title, the author, and the relationship concept “author contribution,” a computer can link the three URIs together to “understand” that “this specific person” has an “author contribution” relationship to “this specific work title,” as shown in the triple statement in [Figure 1](#).

However, as Steele points out, “[t]he Semantic Web needs more than just RDF triples to understand linked data.”¹⁸ Pulling library metadata out of catalog siloes will be a two-step process. The first step applies URIs for metadata such as authors from an established name authority file (e.g., the LC/NACO Authority File). When Semantic Web resources such as Wikidata also link to URIs from the same name authority file, computers can then “understand” that any resource making relationship statements using that URI is referring to the same person as in the library catalog.

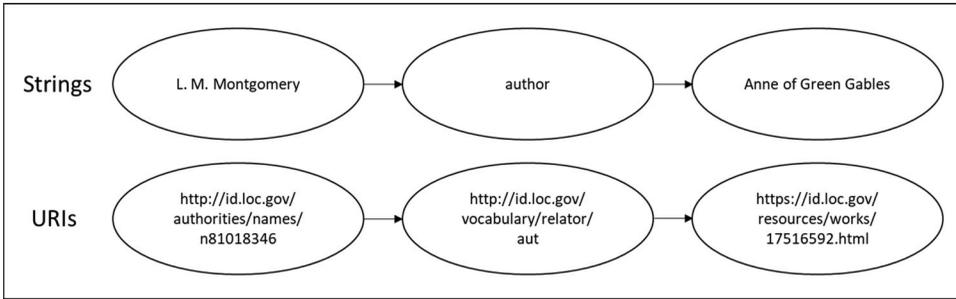


Figure 1. Example of a triple statement.

The real potential of linked data for libraries is that by connecting one URI from a library catalog to the Semantic Web, a computer can infer many additional relationships about that URI within the Semantic Web.

The second step to bring library metadata out of its silo is a structure for library metadata relationships, and corresponding URIs for each of those relationships. Humans inherently know that an author can have multiple roles and relationships, but computers need the structure of these roles and relationships explicitly described in vocabularies. To enable inferencing, computers rely on ontologies, complex vocabularies that define the structure of relationships within a particular domain, such as the various possible relationships between a work and a person, or between a person and an organization.

Just as there are multiple domains of knowledge, multiple ontologies have been developed that attempt to accurately reflect each universe of knowledge. Although individual ontologies model specific domains with different levels of granularity, they can have overlapping elements and can be related to one another. The strength of an ontology such as schema.org is that it is general enough that it can be applied to almost any domain and is thus frequently chosen by those who want to link their data widely. In comparison, for the bibliographic domain BIBFRAME aims to be specialized enough to cover the description required for different kinds of works, people, organizations, and events, while general enough to support a simplified expression as schema.org.

Modeling library data

As described in Park and Kipp,¹⁹ librarians initially developed multiple granular linked data ontologies for different library formats, resulting in a lack of interoperability between records. The International Federation of Library Associations and Institutions (IFLA) developed the Functional Requirements of Bibliographic Records (FRBR) conceptual model in the 1990s as a library-oriented ontology general enough to apply to all

formats.²⁰ The IFLA Library Reference Model unites FRBR with its partner conceptual models Functional Requirements for Authority Data (2009) and Functional Requirements for Subject Authority Records (2010),²¹ relating to authority and subject data respectively. FRBR introduced the “WEMI” core structure, which refers to a Work (W), which can have multiple Expressions (E), which in turn can have multiple Manifestations (M), which in turn can have multiple related Items (I). Nearly all library-based ontologies can now be mapped back to the WEMI structure, leading to better interoperability.

BIBFRAME linked data model

Initially introduced in 2012, and replaced with BIBFRAME 2.0 in 2016, BIBFRAME’s underlying conceptual model simplifies the WEMI structure by combining Work and Expression together at its highest level, followed by Instance and Item, roughly equivalent to FRBR Manifestation and Item.²² At the BIBFRAME Work level are relationships concerning elements such as creator and subjects. At the Instance level are relationships concerning publishing information and format. And at the Item level are relationships concerning the physical items held at a library, such as barcodes and shelf numbers.

Although not one of the core classes, BIBFRAME does include a relationship property for an expression of a work, and thus allows for a reflection of the full WEMI structure within its conceptual model.²³ In 2016, three key concepts of Agents, Subjects, and Events were added to apply relationships to BIBFRAME’s three main core classes and their subclasses.²⁴

Like other Semantic Web ontologies, Kroeger notes “BIBFRAME is a linked data entity-relationship model based on the Resource Description Framework (RDF),”²⁵ meaning that BIBFRAME enables the connection of library metadata to the Semantic Web. Each record in a catalog can be parsed into a series of triple statements using BIBFRAME to describe the relationships. BIBFRAME makes the structure of these relationships explicit, and ultimately connects each of those relationships back to its three-part structure of the Work, the Instance, or the Item as applied for a particular resource and within the catalog as a whole.

Because of its interoperability with the WEMI structure, a significant number of large libraries are moving or have moved to BIBFRAME, including LC. The question for other libraries is less about whether they will move to BIBFRAME, but when a library will make that choice. The two major factors in making the decision of when to transition from MARC to BIBFRAME are how well a library organization understands BIBFRAME,

linked data, and their benefits, and the practical readiness of an organization to make such a large transition.

Previous assessments of BIBFRAME

To the knowledge of the researchers, no other survey has been aimed at assessing the readiness for and knowledge of BIBFRAME within a large general library community including all types of libraries (academic, public, school, and special). However, there are a few surveys that have previously looked at knowledge of BIBFRAME and linked data within cohorts of primarily large libraries, and primarily among cataloging and systems librarians. In 2014, the PCC distributed a survey to its members and their colleagues in “vendors, systems, acquisitions, and other areas.”²⁶ Additionally, in 2014, 2015, and 2018, OCLC conducted surveys of “linked data implementers” to “learn details of specific projects or services that format metadata as linked data and/or make subsequent uses of it.”²⁷

Assessing understanding of BIBFRAME

Canadian libraries cannot be fully ready to make a transition from MARC to BIBFRAME unless individuals within the libraries have an understanding of BIBFRAME, and of the costs and benefits of making such a transition. This raises the fundamental question of “How can understanding be defined and assessed?” Baumberger explains “objectual understanding” as “a relation between an agent, a subject matter and a theory,” specifically that “agent A understands a subject matter S by means of a theory T.”²⁸ For an objectual understanding of BIBFRAME, the metadata person (A) must understand the representation of bibliographic information (S) through BIBFRAME as a linked data model (T). In addition, BIBFRAME (T) must hold up within a bibliographic context (S), and the metadata person’s (A) commitment to BIBFRAME for representing bibliographic information must be justified through their understanding.

Stuart asserts that proving understanding of a concept consists of two kinds of tests. In the first test of meaningfulness, one is “asked to demonstrate a grasp of the meaning of a concept, idea, or theory” and in the second test of fruitfulness, one is “asked to do something with an idea, concept, theory, or model.”²⁹ In the current study, meaningfulness might be measured by answering a question identifying the pieces of an RDF triple, and fruitfulness might then be measured through the application of an RDF triple to a relationship within the bibliographic universe. Baumberger takes the “fruitfulness” aspect of understanding further to explain that “understanding comes in degrees.”³⁰ For example, the degrees

of understanding for a cataloger using BIBFRAME to describe items in their catalog likely differ from those for a systems librarian to build a discovery layer over various sets of metadata (BIBFRAME or otherwise). In the context of a group or institution understanding a concept, Baumberger points to understanding at a “collective agent” or “extended system” level,³¹ which gives credence to the current study assessing an individual library (as an extended system) to have an understanding of BIBFRAME.

To understand the BIBFRAME linked data vocabulary, Sprochi posits one must first understand fundamental concepts of linked data and recognize that the use of BIBFRAME requires a move from the idea of the bibliographic record as a single unit, a “flat file,” to a more three-dimensional approach elevating the connections among individual pieces of metadata.³² Considering the fundamentals to understand BIBFRAME, Christman and King note that a user must first understand the use of URIs and the subject-predicate-object relationships in RDF. Second, a user should understand the structure of the BIBFRAME vocabulary, including base classes that must appear in a description, BIBFRAME statement properties, and how to express something using BIBFRAME. Third, a user should understand how BIBFRAME functions with other vocabularies.³³ Additionally, on a practical level, a user should have some understanding of how their library might implement a transition from MARC to working in the BIBFRAME format.

The choice to use closed-ended questions, in research methods as in education, is often one of practicality. For the participants in a study, closed-ended questions are cognitively less demanding.³⁴ For researchers, closed-ended questions are easier to analyze.³⁵ As measures of understanding, however, closed-ended questions have limitations, and a correct answer is not necessarily a sign of understanding.

The use of multi-tier questions, in which secondary questions are used to assess the reasons for choosing or to assess confidence in a first answer, have been proven to be a more effective method to assess understanding.³⁶ In particular, assessing confidence allows for separation of those who get the answer correct and have high confidence in their answer (demonstrating understanding) from those who get the answer correct, but do not have high confidence in their answer (making a best guess). It also allows for identification of those who get the answer incorrect with high confidence they answered correctly (overestimating their understanding), and those who get the answer incorrect with correspondingly low confidence in their answer (admitting they do not know).

As discussed by Ylikoski there is often a disconnect between the real understanding of a concept and a person’s feeling of understanding,³⁷ which can be a highly fallible indicator of actual understanding.³⁸ Taking

this into consideration, rather than relying on self-reported understanding of BIBFRAME, the current study empirically assessed a respondent's understanding of BIBFRAME by administering a series of questions with multiple-choice answers. To mitigate the effects of random guessing, each question was accompanied by a self-rated ranking of confidence in the correctness of the respondent's answer. The researchers interpreted the correspondence of a correct answer with a high self-reported level of confidence as an indication of understanding.

Assessing readiness

Organizational readiness for change is an important factor in the successful implementation of new technologies. Weiner and colleagues argue that readiness for change consists of two primary factors, both of which must be present for success: motivation and capability.³⁹ That is to say, organizational members must be both willing and able to change. Using Weiner's theory of organizational readiness for change,⁴⁰ Shea and colleagues developed a measure that addresses two facets of readiness for change: change commitment (level of commitment, change valence) and change efficacy (task knowledge, resource availability, and situational factors).⁴¹ This instrument includes a five-item scale about change commitment, a six-item scale about change efficacy, and nine items representing various aspects of how much value respondents would place on a change.

Methods

An online survey in English and French using Qualtrics software was conducted to obtain a portrait of the Canadian library community, defined as libraries and library consortiums. A stratified random sample of 1,500 libraries was generated from 5,812 Canadian libraries compiled from libraries.org and Library and Archives Canada's interlibrary loan database clustered into four mutually exclusive categories:

- Academic libraries (6%): college and university libraries;
- Public libraries (36%): either individual libraries or centralized technical services for a public library branch system;
- School libraries (14%): either individual school libraries or centralized technical services for a school district; and
- Special libraries (44%): libraries serving corporations, hospitals, the military, museums, private businesses, or the government.

To reach the people who would be most likely to have knowledge of any transition to BIBFRAME, metadata specialists and systems specialists were targeted in the invitation.

An initial pilot test was conducted in June 2019 to receive feedback on the survey questions by members of the Canadian BIBFRAME Readiness Taskforce, and a second pilot test was conducted in September 2019 to test the effectiveness of the distribution method. Based on the pilots and comments received, the questions in the survey were reduced and reorganized. The invitation email was also revised to emphasize that recipients who had not previously heard of BIBFRAME should also participate in the survey.

The final survey included three sections.⁴² The first section collected demographic data about the respondent's library and their role within the library. At the end of the first section, if the respondent indicated they had not heard of BIBFRAME as a replacement for the MARC format prior to receiving the survey, they were brought to the end of the survey. If the respondent indicated they had previously heard of BIBFRAME, they were asked to complete the other two sections of the survey. The second section assessed their organization's readiness to transition to BIBFRAME using a psychometric assessment that measured organizational readiness for implementing change.⁴³ The third section assessed the respondent's understanding of BIBFRAME through a series of multiple-choice questions covering linked data and BIBFRAME fundamentals. To mitigate the effects of random guessing, each question contained "I don't know" as an option and was accompanied by a self-rated ranking of confidence in the correctness of the respondent's answer.⁴⁴

The survey was launched on November 14, 2019 by sending emails with a link to complete the survey in English or French targeting "the person most directly responsible for cataloging" and "the person most directly responsible for systems." The research team distributed the survey to each institution's generic contact email address, as results from the pilots indicated no difference in response rate between a generic email address or using direct email addresses of catalogers and system librarians. Using a generic email address for each institution also ensured a uniform method of contact across libraries, regardless of their size. To replace emails that failed to be delivered, invitations were sent to another 125 libraries. Two reminders were sent before the survey closed on December 31, 2019, and 289 completed questionnaires were received. Two responses were rejected on the basis that they did not come from a Canadian library, resulting in a total of 287 analyzed questionnaires (19% response rate).

Data were subjected to a descriptive statistical analysis, as well as chi-square tests and analyses of variance to explore relationships between variables. To ensure a rigorous analysis, two of the researchers analyzed the data in parallel, one using SPSS and another using Python pandas.

The data set used for the analysis, after being cleaned to ensure the anonymity of participants, has been made available through Borealis.⁴⁵ To further the anonymity of participants, the answers for the question regarding the province in which the library is located was deleted from the published data set, as the analysis showed this variable did not interact with any other variables.

Results

Description of sample

Questionnaires were returned from institutions located in the ten provinces and one territory. The percentage of responses received by aggregated regions across Canada were in line with distributions from the 2016 Census numbers, with Central being greatest, then the West, Atlantic, and North. Fifty-three percent reported having a catalog in English only; 29% a catalog in French only; and 17% a multilingual catalog.

The proportion of public libraries (36%) follows their weight in the sample while academic libraries (16%) are over-represented, and special libraries (37%) and school libraries (9%) are underrepresented. The majority of libraries (65%) surveyed employ 1 to 5 librarians while 19% employ none. The majority of libraries (57%) report having 1 to 5 staff members. The participants' primary responsibilities within the library vary greatly, the three most common being administration (22%), cataloging and metadata (19%), and "all of the above" (17%). A finer analysis of the answers indicates that 38% have "cataloging responsibilities." Nearly three quarters of the participants (74%) are responsible for training other employees, while 46% have other employees reporting to them.

Awareness of BIBFRAME

The results first indicate that, overall, only 30% of respondents were aware of BIBFRAME as a replacement for the MARC bibliographic format prior to the survey. When analyzed by library type, this proportion is higher for academic libraries (69%), and lower for public libraries (28%), special libraries (19%) and school libraries (19%; $\chi^2(4, N=286) = 40.8, p < .001, V = .38$; see [Figure 2](#)). The proportion is also higher for libraries having more than 5 librarians (6–10, 57%; 11–20, 85%; 21–50, 88%; >50, 50%; $\chi^2(5, N=286) = 47.91, p < .001, V = .41$; see [Figure 3](#)) or more than 5 staff members (6–10, 31%; 11–20, 46%; 21–50, 52%; >50, 75%; $\chi^2(4, n=285) = 50.14, p < .001, V = .42$; see [Figure 4](#)). Of the 16% of respondents whose libraries report holdings to OCLC, 62% had heard about BIBFRAME prior to the survey ($\chi^2(2, N=286) = 34.5, p < .001, V = .38$).

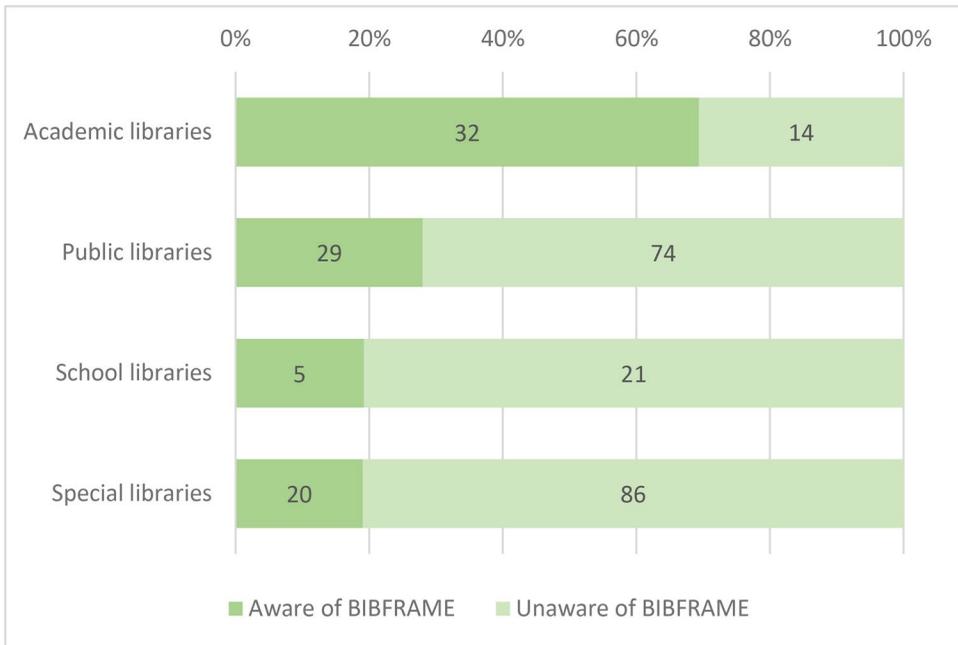


Figure 2. Interaction between awareness of BIBFRAME and library type.

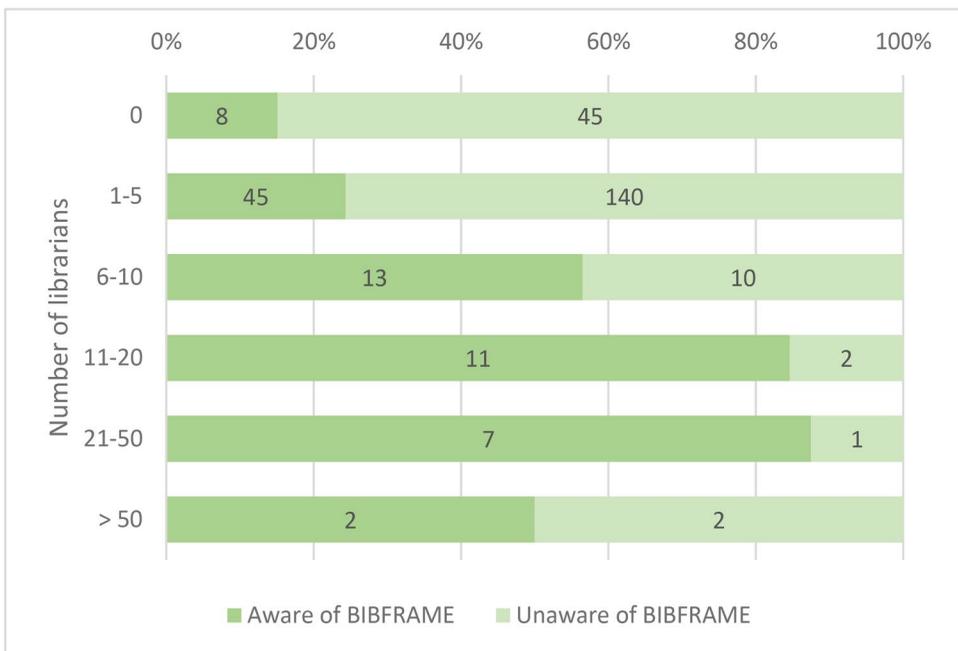


Figure 3. Interaction between awareness of BIBFRAME and number of librarians.

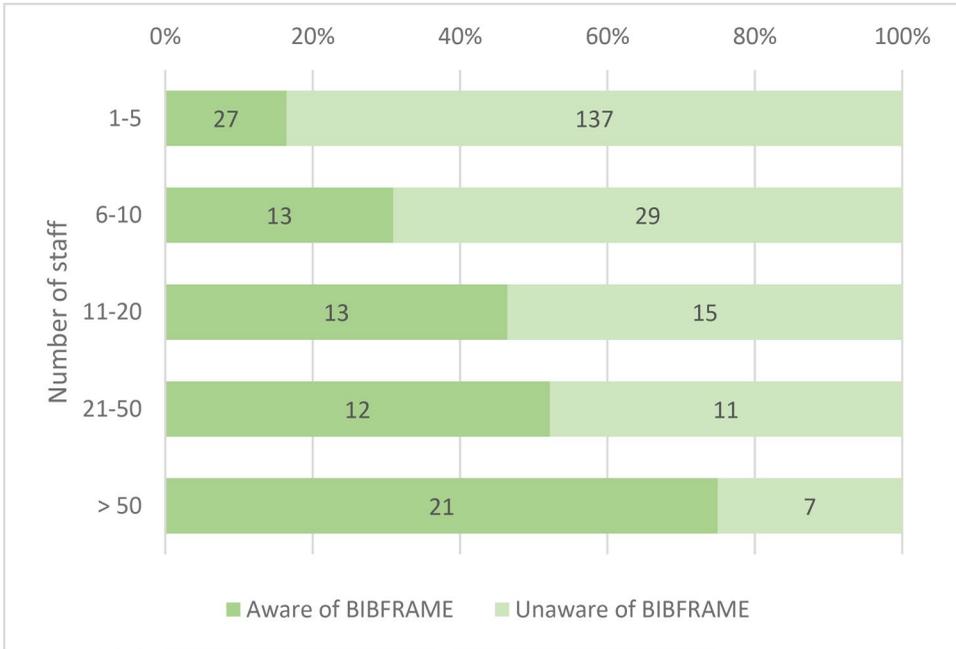


Figure 4. Interaction between awareness of BIBFRAME and number of staff.

Respondents who indicated “cataloging and metadata” (54%), “systems” (39%), or “technical services” (38%) as their primary responsibility were also more likely to be aware of BIBFRAME in comparison to respondents who had other roles, including “all of the above” (14%; $\chi^2(10, N=286) = 28.34, p = .002, V = .32$).

Understanding of BIBFRAME and related concepts

Respondents who indicated that they had heard of BIBFRAME prior to the survey ($n=87$) were invited to answer a series of seven multiple choice questions and three multiple answer questions designed to evaluate their knowledge of linked data fundamentals, BIBFRAME vocabulary, BIBFRAME and other vocabularies, and BIBFRAME hands-on.⁴⁶ For each question, “I don’t know” was provided as a possible answer, and results show it was the most frequent answer for all ten questions. Secondly, except for Question 1, which has 44% of correct answers, the rate of correct answers is generally low. For the seven multiple choice questions, four have more correct answers than wrong answers, and three have more wrong answers than correct answers (see Table 1).

For the three multiple answer questions (where respondents were asked to select all correct answers), an answer was considered correct when all the correct choices and no wrong choice were selected.

Table 1. Distribution of answers for multiple choice questions measuring the understanding of BIBFRAME.

Questions	Correct answer	Wrong answer	"I don't know."
1 True or false: every RDF triple consists of exactly one subject, one predicate, and one object.	44%	7%	49%
2 True or false: each of the subjects, predicates, and objects of an RDF triple must be associated with a uniquely identifying link, called a Uniform Resource Identifier (URI).	12%	42%	46%
4 To represent a resource in your library collection, what are the base classes that must appear in a description using the BIBFRAME vocabulary?	23%	33%	44%
5 What set of BIBFRAME statements properly represents the Dewey Decimal call number of a book in your library collection?	14%	11%	75%
6 When the subject heading is identified by a link, what is the best way to express a subject heading for a book using the BIBFRAME vocabulary?	11%	13%	76%
9 What kind of interface will most cataloguers use to create a resource description in BIBFRAME?	21%	8%	71%
10 How will most people find library resources that have been described with BIBFRAME?	33%	10%	57%

If the respondent selected some but not all correct answers, or selected a mixture of correct and incorrect answers, the researchers considered these to be “partially correct answers.” No respondents selected only incorrect answers (see Table 2).

The association between the choice of an answer and confidence ratings (1 = “No confidence”; 5 = “Full confidence”) were analyzed for each question, and a significant association can only be found for two of the ten questions. For question 2 (see Table 1), respondents who provided the correct answer were more likely to select a confidence rating of “3” and respondents who provided the wrong answer were more likely to select a confidence rating of “4” ($\chi^2(4, n=45) = 13.55, p = .009, V = .55$). For question 3 (see Table 2), respondents who provided all correct answers were more likely to select a confidence rating of “4” or “5” and respondents who did not provide all the correct answers were more likely to select a confidence rating of “1,” “2” or “3” ($\chi^2(4, n=31) = 10.70, p = .03, V = .46$).

There is an association between two demographic variables and answers from five questions. Respondents from academic libraries were more likely to answer correctly question 1 ($\chi^2(6, n=84) = 15.83, p = .015, V=0.24$) and question 2 ($\chi^2(6, n=83) = 12.85, p = .045, V = .2$).

Table 2. Distribution of answers for multiple answer questions measuring the understanding of BIBFRAME.

Questions	Entirely correct answer	Partially correct answer	"I don't know"
3 Select each valid RDF serialization in the following list: JSON-LD, MARC, N-Triples, RDA, RDF/XML, Turtle.	10%	28%	63%
7 Select each of the vocabularies that can be used with BIBFRAME: Bibliographic Ontology (BIBO), Dublin Core Metadata Initiative (DCMI), Schema.org, Resource Description & Access, FRBR-aligned Bibliographic Ontology (FaBiO).	5%	41%	54%
8 Select all of the sources of links that BIBFRAME allows for use as identifiers in resource descriptions: Library & Archives Canada (lac-bac.gc.ca), Library of Congress (id.loc.gov), Online Computer Library Center (oclc.org), Virtual International Authority File (viaf.org), Wikidata (wikidata.org), Any web domain.	15%	23%	63%

The number of librarians in the institution where the participant works also has a significant relationship with the likelihood of all correct answers for question 3 ($\chi^2 (5, n=80) = 15.43, p = .009, V = .44$). Participants from libraries employing fewer librarians were more likely to answer "I don't know" for question 5 ($\chi^2 (10.0, n=84) = 20.93, p = .022, V = .25$), question 6 ($10, n=83) = 24.13, p = .007, V = .38$) and question 9 ($\chi^2 (10.0, n=83) = 32.77, p < .001, V = .37$).

Organization readiness for BIBFRAME

Respondents who indicated that they had heard of BIBFRAME prior to the survey ($n=87$) were also invited to answer questions regarding their readiness to transition to BIBFRAME. Results indicate that, even for those who were aware of BIBFRAME, participants were neither committed nor opposed to transition. Results do not indicate interactions with any of the demographic variables. Participants were invited to rate their level of agreement with 5 items measuring their library's commitment to transition from MARC to BIBFRAME from 0 to 10, and the average for this commitment score is 19 (out of 50). Participants were also invited to rate their level of agreement with 6 items measuring their library's ability to make the transition from 0 to 10, and the average for this ability score is 26 (out of 60). Finally, they were asked to rate 9 items measuring different aspects of the perceived needs, benefits, and harms for their library to make the transition (such as cost-effectiveness and timeliness of the

transition), and scores for individual items all have a median of 5 or 6 (out of 10).

Planned transitions to BIBFRAME

The results also indicate that 85% of the libraries surveyed do not yet know enough about BIBFRAME to consider planning a transition. This proportion is slightly lower for academic libraries (82%), school libraries (82%), and special libraries (81%), and slightly higher for public libraries (91%; $\chi^2(24, n=271) = 45.5, p = .005, V = .21$). For other variables measured, no specific trend can be observed. Only 1% of the libraries surveyed indicate their transition from MARC to BIBFRAME is already underway. Among the libraries planning a transition, only 4% plan to transition within the next ten years, which mirrors the proportion of libraries (4%) who plan to keep using MARC records and not transition to BIBFRAME.

Discussion

Most respondents were not aware of BIBFRAME

The most surprising and significant finding of the survey was that 70% of respondents were unaware of BIBFRAME as a replacement for the MARC bibliographic format prior to receiving the survey. The “BIBFRAME project was initiated in 2012,”⁴⁷ meaning that at the time of the survey in late 2019, there had been the introduction, discussion, and development of BIBFRAME for almost eight years. The only other study the researchers are aware of that assessed awareness of BIBFRAME was a 2014 survey conducted by the PCC.⁴⁸ The objective of the PCC survey differs from the current one as its questions focus on awareness of communication and education regarding BIBFRAME, rather than awareness of BIBFRAME’s existence. The PCC survey concluded, among other things, that “there is a clear understanding that BIBFRAME will replace MARC, and that it will provide a new bibliographic environment”⁴⁹—a stark contrast with the results of the current study.

In addition to the different objectives, the discrepancy in awareness between the two studies could be linked to the size of the libraries surveyed and regional access to information. Most respondents from the current survey were from smaller libraries: over 80% of libraries employed 5 or fewer librarians, and a majority also reported having only 1 to 5 staff members. Results from the current survey also showed a significantly higher proportion of respondents previously aware of BIBFRAME both at

libraries that were larger (having more than 5 librarians employed) and at academic libraries, which tend to both be larger and better connected with libraries outside of Canada. PCC survey respondents were also likely larger libraries, as PCC membership indicates a library is large enough to have at least one librarian or staff member dedicated to meet PCC standards for cataloging and authority work. Further, the majority (78.46%) of respondents in the PCC survey had cataloging among other responsibilities. In contrast, less than half (38%) of respondents to the current survey indicated having “cataloging responsibilities.” The PCC survey was vulnerable to self-selection bias, as rather than using a systematic sampling method, the survey “was distributed to the PCC and other discussion lists [...] and PCC members [were asked] to share the survey widely,” and thus those who were already aware of BIBFRAME were more likely to respond.⁵⁰ PCC members were also more likely to be aware of BIBFRAME as they receive regular, direct communication regarding LC projects, such as the development of BIBFRAME.

Respondents who were aware of BIBFRAME usually knew little about it

The second finding of interest was that “I don’t know” was the most common answer to all of the questions designed to measure understanding. The rate of respondents selecting “I don’t know” was just below 50% for introductory “true or false” questions. The rate of respondents selecting “I don’t know” then increased (up to 76%) for detailed questions regarding the BIBFRAME vocabulary or practical aspects related to the use of BIBFRAME.

With the exception of an introductory question about the elements of the RDF triple, for which 44% of respondents answered correctly, all questions measuring understanding had a low rate of correct answers, as low as 11%. In retrospect these questions were not necessarily easy to answer but did capture the fundamental elements necessary to understand linked data in preparation for a transition from MARC to BIBFRAME, as understood by a group of experts working toward implementing BIBFRAME in Canadian libraries.

The first two questions were true/false questions, and interestingly Question 1 (correct answer = “true”) had a high percentage of correct answers, and Question 2 (correct answer = “false”) had a low percentage of correct answers. This pattern could be due to an acquiescence bias, essentially that people prefer to say “yes,” “true,” or otherwise agree with a statement rather than disagree.⁵¹ An acquiescence bias is somewhat confirmed by the significant relationship between respondents’ answers and corresponding low confidence in their answers to Question 2 (correct answer = “false”).

The only other question with a significant relationship between the answers and the confidence rate was Question 3, where those who answered correctly were more confident in their answer. This could be explained by Question 3's structure as a "multiple answer" question, where respondents were to "Select each valid RDF serialization in the following list: JSON-LD, MARC, N-Triples, RDA, RDF/XML, Turtle." Those who selected all the correct answers had to be confident in their selection, rather than having the option to "make a guess" as is possible in answering a multiple-choice question.

The analysis of responses to understanding questions in the current survey revealed significant gaps in general knowledge of linked data and concepts related to BIBFRAME. The survey was designed to measure actual knowledge instead of relying on self-reported ranking of knowledge. As has been documented in self-reported measures, people often consciously or unconsciously distort their answers to make themselves seem more favorable.⁵² And as Keil explains, "People of all ages tend to be miscalibrated with respect to their explanatory understandings; that is, they think they understand in far more detail than they really do how some aspect of the world works or why some pattern in the world exists."⁵³ Testing knowledge as was done in the current survey also revealed the areas in which respondents have greater and lesser understanding.

Respondents were neither committed nor opposed to transition

Given that most respondents were not aware of BIBFRAME and that those who were aware knew little about it, it is unsurprising that an overwhelming majority—85%—of the libraries surveyed considered not knowing enough to plan a transition. As well, it can be stated with certainty that the 70% of participants who were not aware of BIBFRAME previous to receiving the survey cannot be ready. Since there are only a few implementations outside of select major institutions, one could postulate that there has been no practical need for many to pay attention to BIBFRAME so far, especially in small institutions, which form the majority of the libraries surveyed. The analysis of the readiness questions, which were only answered by those who were previously aware of BIBFRAME did not reveal much, partially because so few respondents had actually heard of BIBFRAME. Also, organizational readiness for a change as theorized by Weiner, is likely to be highest when organizational members feel confident they can implement the change,⁵⁴ which is impossible to accomplish when one knows so little about it. The analysis does reveal, though, that participants were also not opposed to making a transition from MARC to BIBFRAME. This lack of opposition indicates the authors' openness to

learn more in order to improve understanding and to become ready for this organizational change.

The transition from MARC to BIBFRAME, which has begun within major institutions in the international library community, will require broad participation to achieve full implementation, including participation from smaller institutions. The readiness for a change among the individuals within an organization is one of the first indicators of whether the organization as a whole can become ready for the change. Adeyemi and Omopupa, who examined “perceived knowledge and readiness” for a transition to integrated discovery systems within the Nigerian library community, observed that library leaders need to ensure that individuals are prepared and ready for change before implementing change.⁵⁵ But in order to prepare others, the library leaders must first be ready and committed to change. The current survey targeted those individuals in libraries who would most likely lead a transition from MARC to the BIBFRAME format. Survey results indicate these library leaders are overall not yet ready—a situation that library schools and associations should begin to address.

What does this mean for the training of future information professionals?

Based on the results, one should not take for granted that Canadian librarians, library technicians, and library administrators already know about BIBFRAME, nor that they are ready for a transition from the *one record for one resource* model to a structure that presents the relationships between discrete elements of resources. To prepare graduates of library and technical services programs for a transition to BIBFRAME, training will be necessary to bridge the gap between theory and practice.

Cataloging, as pointed out by Joudrey and McGinnis, has been covered minimally in library schools.⁵⁶ Hider confirms that assessment, explaining that due to the concentration of record creation and editing among “a small number of ‘elite’ libraries” as well as the provision of records by vendors, cataloging is no longer being taught comprehensively in library schools as it is increasingly seen as a “niche” practice.⁵⁷ As hinted by Hudon, there is also a decline in full-time faculty members specialized in knowledge organization, and courses on the topic are often taught by instructors not conducting research nor practicing in the area.⁵⁸ Cataloging courses have been replaced by general introductions to information organization that tend to cover a wide range of topics as an overview, rather than teaching advanced usage of theoretical frameworks and standards used in the field. Specifically, BIBFRAME and linked data as topics do not seem to be given prominence within ALA-accredited library schools. Salaba’s study of knowledge organization requirements in LIS graduate

programs shows that linked data is only lightly covered among topics in core and elective course offerings. For the 60 core courses analyzed in the study, linked data is one of the least frequent themes. Electives dedicated to linked data are also rare.⁵⁹ Data collected by Dobreski and colleagues in a keyword analysis of syllabi for courses related to information organization and information retrieval further indicate that neither linked data (11 occurrences within 58 syllabi) nor Semantic web (8 occurrences) are taught universally in ALA-accredited programs.⁶⁰ Students can graduate from library school never having been introduced to the idea of linked data at more than a superficial level.

Rather than general offerings on information organization, library schools should consider introducing mandatory courses providing foundational knowledge on cataloging, metadata, and structured data to cover the history, current use of metadata in digital resources, and the future of linked data and BIBFRAME. One explanation for the lack of library school offerings on linked data could be attributed to the lack of its mention within current professional competencies. For example, the Core Competencies for Cataloging and Metadata Professional Librarians only mentions linked data as something to be aware of as a major trend.⁶¹ The Canadian Association of Research Libraries Competencies 2020 final report promotes “understanding how information is organized for easy identification and retrieval, including cataloging and metadata standards for all formats” without mentioning linked data.⁶²

The 2006 Training Gaps Analysis for Librarians and Library Technicians report published by the Government of Canada’s Cultural Human Resources Council provides infrequent and rather general coverage of technical and bibliographic skills. Not much can be gleaned from the analysis regarding cataloging and other technical skills, other than they have not been emphasized as important in LIS programs as of 2006.⁶³ As it has been over 15 years since this report was published, it is time to reassess this analysis in Canada and to collect more data specific to cataloging and metadata training gaps.

LIS graduates who hope to be successful in their job searches will continue to need knowledge of previous and current cataloging practices. MARC bibliographic records are not disappearing anytime soon, and MARC 21 knowledge remains the most requested cataloging skill in job advertisements, as found in 2022 by Brannon and colleagues.⁶⁴ Sibiyi and Shongwe, who published the only other study since 2010 to look at the implications of cataloging job requirements for library school curricula, found that traditional standards taught in library schools, such as MARC 21, still support job requirements as listed in advertisements for catalogers.⁶⁵ Only one of the ten position titles (“assistant metadata librarian”)

listed in the job advertisements they analyzed did not include the term “cataloger” or “cataloging.” More recently, Brannon and colleagues note that “metadata” is the “word featured in emerging position titles” and that “experience with linked data is a new preferred qualification,”⁶⁶ reflecting an increased need for training in metadata and structured data.

Cox and Myers note that since the mid-1990s librarians have taken on more administrative duties,⁶⁷ meaning that cataloging and systems librarians will likely be the ones leading Canadian libraries in the transition from MARC to BIBFRAME. There is thus increasing importance for library schools to teach the foundations of cataloging, as without a strong understanding of MARC and its associated standards, a transition of the fundamental goals and elements of cataloging to a new framework such as BIBFRAME will not be possible.

What will the transition look like for the rest of us?

Leading in Canada, the University of Alberta announced its Linked Data Implementation Plan in January 2022.⁶⁸ The University of Alberta has been able to get to this point in its transition largely due to collaboration with international partnerships, such as Linked Data for Production, Share-VDE, and the PCC. As a large academic institution, the University of Alberta has the funding, support, and positioning within the international library community to be an early adopter of BIBFRAME. In comparison, most of the Canadian libraries who responded to the survey have five or fewer staff or librarians. These smaller libraries will almost certainly need to wait for larger libraries to first implement and further develop BIBFRAME systems with vendors, before they will be able to make the transition themselves.

As we move to increasingly structured data, libraries will rely on vendors to accommodate both MARC and BIBFRAME formats within library systems. Although there is a lot of development, there are currently no off-the-shelf library systems that fully support encoding, indexing, and discovering metadata as BIBFRAME. Based on Folsom’s guess that ultimately “it will be a combination of different types of data that replace MARC, not just linked data,”⁶⁹ we should also prepare ourselves for hybrid environments that include and integrate formats beyond MARC and BIBFRAME.

Continuing education activities will be necessary to prepare those who are already working in libraries and within the profession, especially considering the certainty as noted by Folsom that “copy cataloging and the shared effort for bibliographic descriptions is not going away even if it’s no longer strictly done using MARC.”⁷⁰ BIBFRAME training has been available for several years. In their 2018 survey of library workers participating in continuing education, Tosaka and Park found that 28.6% of

respondents reported engaging in linked data training, with 23.5% engaging specifically in BIBFRAME training.⁷¹ One explanation for the difference in results between Tosaka and Park and the current study is that in order to participate in training, respondents would have to be previously aware of the existence of linked data or BIBFRAME. Another difference between the studies is in the demographics of respondents: roughly 80% of Tosaka and Park's respondents were catalogers, metadata specialists, or heads of cataloging or metadata departments, whereas fewer than 40% of respondents to the current study were classified as having cataloging or metadata responsibilities.

Through their capacity to be early adopters and offer continuing education, members of the Canadian academic community have a role to play in fostering the understanding of linked data principles and supporting the transition of the Canadian library community to the BIBFRAME format. As proposed by Bigelow and Pretty, the Canadian library community might choose to develop a "BIBFRAME Canadian Knowledge Exchange"⁷² following the example of the RDA Canadian Knowledge Exchange, which starting in 2010 assisted Canadian libraries to move from AACR2 to RDA.⁷³ Other libraries might also be looking to Library and Archives Canada (LAC) and waiting to start their transition from MARC to BIBFRAME until LAC has taken its first steps.

First and foremost, the next step for catalogers and others working in libraries is to transition the way they think about and conceive of the catalog. Rather than string literals and *one record for one resource*, to successfully implement BIBFRAME the catalog itself will need a different structure that presents the relationships between discrete elements of resources as represented through URIs. In essence, library data needs to be restructured so it can engage and interconnect with other data on the Semantic Web—to "place our data and resources where people are searching" as Schreuer envisioned.⁷⁴ In any case, the ability for a library to transition from MARC to BIBFRAME depends upon both the library systems and people working with them transitioning toward a structure for bibliographic data based on relationships rather than records.

Conclusion

Findings

This study has shown that Canadian libraries are not yet ready to transition from MARC to BIBFRAME, which represents an important gap between theory and practice in the field that must be addressed through advocacy and professional training. This is not a phenomenon restricted only to Canada. The eventual adoption of BIBFRAME by libraries around

the world will represent a major technological shift requiring an evolution of professional skills. A large percentage of libraries, including many smaller ones, will need training to increase understanding of BIBFRAME and linked data principles before “organizational readiness” for such a transition can be considered.

A transition away from MARC records to BIBFRAME format is only the first step in the larger changes that will be required for systems to support library linked data in the Semantic Web. Although BIBFRAME has been adopted by several libraries around the world, the only way to currently share BIBFRAME data among libraries is by converting it back into MARC records. The work of those such as the BIBFRAME Interoperability Group⁷⁵ will be essential as the library community moves out of a hybrid environment to a complete transition from MARC to BIBFRAME, including holdings records and discovery layers.

Linked data in libraries has become more than a major trend. In consideration of sharing beyond libraries, “as different vendors offer to publish library data as linked data, it becomes really important to allow discovery of, and linking between, entities on these platforms.”⁷⁶ Community groups such as Bibframe2Schema.org are pursuing reference mapping between BIBFRAME and other Semantic Web ontologies. Vendors are increasing connectivity between MARC records and Wikidata, as well as facilitating the insertion of URIs in the subfield 0 of controlled fields.

It is time that linked data become part of the core competencies frameworks that guide LIS education and be given a more prominent place in both master’s level and technical programs. Actions to take in Canada could include a refresh of the 2006 Cultural Human Resources Council report on training gaps, an assessment of MLIS and library technician curricula to determine coverage of linked data and BIBFRAME, and an update of the Canadian Association of Research Libraries Competencies to include linked data. Courses on knowledge organization need to be refocused to provide students with the foundational knowledge that is necessary to understand the history of cataloging and structured data, the current use of metadata, and the future of linked data in libraries. These are fundamentals that all library students should be familiar with upon graduation to ensure the library community can move effectively from the *one record for one resource* paradigm to see the full impact of library linked data in the Semantic Web.

Limitations

The current study was conducted with the conscious objective to avoid the response bias that might occur from a general call for survey

participation to a library technical services-focused mailing list. The researchers sought to draw a portrait of the Canadian libraries as a whole, and although the lists of Canadian libraries used to develop the stratified random sample were very inclusive, it is still possible that some smaller Canadian libraries could have been missed. Considering the results show respondents from smaller libraries are less likely to be aware of BIBFRAME, it is possible the general awareness of BIBFRAME may be even lower.

This is an observation that could be drawn from the response rate as well. While the response rate for this study—19%—is not optimal, it is in line with studies using online surveys. Whether or not a low response rate to a survey creates a problem for representativeness remains a matter of debate, and some studies suggest that a response rate around 20% yields results as representative as studies with higher response rates.⁷⁷ Follow-up with recipients revealed that many either did not recognize the subject of the survey (BIBFRAME) or did not respond as they had no knowledge of BIBFRAME and thus felt their response would not be valuable. That also suggests that the awareness of BIBFRAME among the Canadian library community could even be lower than the results show.

It is also possible that the distribution email did not reach the intended recipient at some libraries. A generic contact email for distribution of the survey was taken from each library's website. The researchers considered if the survey should be sent directly to cataloging and systems librarians when emails on their websites might be available. However, contacting some librarians directly while relying on a generic email contact for other libraries would have created a potential response bias. Requesting that the survey link be forwarded from the generic contact email to the person most directly responsible for cataloging or systems was meant to accommodate for all sizes of libraries, but it was not possible to track to whom the email was forwarded within each library.

Finally, by only assessing the understanding of people who had heard of BIBFRAME, the researchers did not capture the understanding of people who might have been familiar with linked data, though unaware of BIBFRAME as a replacement for the MARC format.

Future research

There are a number of gaps in our knowledge that offer opportunities to build on this work. A similar survey could be conducted in other countries, notably in the United States. The integration of the North American library community in terms of cataloging practices and the reliance on LC in Canada often makes the two countries seem more alike than different. The researchers therefore wonder if administering the current survey

with a stratified random sample of libraries within the United States would show similarly low levels of awareness of BIBFRAME as a replacement for the MARC format. The survey should be repeated in Canada to measure differences in awareness, readiness, and understanding as the implementation of BIBFRAME progresses.

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