Comparison of Key Entities Within Bibliographic Conceptual Models and Implementations

Definitions, Evolution, and Relationships

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With the introduction of FRBR (Functional Requirements of a Bibliographic Record) in 1998, IFLA (the International Federation of Library Associations and Institutes) introduced a new conceptual entity relationship model. FRBR was soon followed by FRAD (Functional Requirements of Authority Data) and FRSAD (Functional Requirements of Subject Authority Data). With LRM (IFLA Library Reference Model) and two descriptive standards, the RDA Toolkit and BIBFRAME to follow, it helps catalogers to have a greater understanding of the entity relationship models they use for bibliographic description. The authors compare the models and descriptive standards. Differences among the entities, their definitions, and properties are examined and analyzed.

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When computers were introduced for the organization of information, Avram's creation of MARC format (machine-readable cataloging) in the late 1960s was an outgrowth of this change. About the same time, the Anglo-American Cataloging Rules were published, and the second edition was published in 1978. Another key standard from this period is the International Federation of Library Associations' (IFLA) International Standard Bibliographic Description for monographic publications (ISBD), published in 1971. These standards dominated cataloging in the US and other countries for several decades. Many technological advances occurred during those decades, resulting in the growth of using computers and shared online databases such as OCLC and RLIN to automate cataloging processes. Additionally, the number and types of resources that required cataloging grew exponentially. This increase in published materials and the necessity for libraries to quickly record their holdings produced the need for an established minimum level of cataloging. For this reason, IFLA decided to adopt new standards of cataloging for both machine processing and humans.[1] This resulted in the publication of FRBR (Functional Requirements for Bibliographic Records), FRAD (Functional Requirements for

Authority Data), and FRSAD (Functional Requirements for Subject Authority Data).

The original IFLA 1997 study, which resulted in the FRBR model, focused on helping users to fulfill their information needs. As Madison stated, "The study's framework was built on the ways data contained in bibliographic records are used through a variety of user tasks, namely to find, identify, select, and obtain," and the concept of user tasks has remained to the present day, although it has been further developed.[2] The study determined that the best way to identify how a bibliographic record (and later authority data) can fulfill these tasks is to use the entity-relationship model. Chen developed this form of modeling in 1976.[3]

FRBR's entity analysis technique began by isolating the entities that are the key objects of interest to users of bibliographic records. "The study then identifies the characteristics or attributes associated with each entity and the relationships between entities that are most important to users in formulating bibliographic searches, interpreting responses to those searches, and 'navigating' the universe of entities described in bibliographic records."[4] The key set of entities introduced by the FRBR model is known as WEMI (Work, Expression, Manifestation, and Item). These entities remain as part of the LRM model, and in modern implementations such as RDA and BIBFRAME (Bibliographic Framework).

FRBR, FRAD, and FRSAD were replaced by the IFLA LRM (Library Reference Model), which also resulted in the restructuring of the RDA Toolkit. The 2017 final draft of the LRM states in its introduction that "the model considers bibliographic information pertinent to all types of resources generally of interest to libraries; however, the model seeks to reveal the commonalities and underlying structure of bibliographic resources."[5] This statement indicates that LRM defines a broad scope for bibliographic description and is intended to be format agnostic.

The Library of Congress (LC) and its partners are developing and testing BIBFRAME to produce linked data to describe holdings. Of the models examined in this project, BIBFRAME is the most overtly designed for production of linked metadata in RDF (Resource Description Framework). RDF is the framework used to describe resources available via the web and is designed to be read and understood by computers. The process of expressing RDF in a computer language is known as serialization, and XML is the most popular serialization format for RDF. It extends the linking structure of the web to name and link relationships between things (usually referred to as a "triple"). "The first step was to make the many large (LCSH, Name Authority File, etc.) and small (language codes, content and media terms, etc.) controlled lists available for use in a linked data application. These controlled vocabularies and lists used for bibliographic description needed to be transformed from print or web formats into RDF to enable their links to be referenced by URIs, making their descriptions accessible in RDF."[6] LC's Linked Data Service began development in 2007. The intent is to make the links both automatic and enhanced. The Service continued with the BIBFRAME project. Because BIBFRAME was explicitly designed to create RDF triples, its entities and their definitions might be expected to differ somewhat from RDA, which is format agnostic. However, because RDA has been modified for LRM, its entity relationship model is RDF triple friendly. RDF triples are metadata built with the classic "entity-relationship-entity" structure. An example of the structure follows: "Charles Dickens"—"is the author of"—"*Bleak House*," which expresses the relationship of Charles Dickens to his work "Bleak House."

Method

To examine how the FRBR, FRAD, and FRSAD conceptual models have evolved and have been implemented since their release, the definitions of several key bibliographic entities that are shared conceptually among FRBR, FRAD, FRSAD, LRM, RDA, and BIBFRAME were compared. Making these comparisons based on the use within each model of the same or similar bibliographic entities was possible; however, in some cases, entities were not part of all models or have been renamed. As shown in tables 1 through 11, some entity definitions have remained the same across the various models and implementations, while others have varied considerably from the original FRBR definitions and its counterparts. Comparing the definitions side-by-side demonstrates how thinking has changed about these entities and the structure of their bibliographic description models. Additionally, relationships between entities within their model structures were examined and compared for evolutionary changes. Because of the number of possible relationships that may be associated with each entity, comparing and presenting each relationship for all of the models was too complex. Instead, an example demonstrating how an "Agent" relationship is expressed is compared between the three models that have "Agent" as an entity.

To construct table 1, entity definitions for FRBR were extracted from Chapter 3.2 Entities in *Functional Requirements for Bibliographic Records: Final Report.*[6] Chapter 3.4 Entity Definitions in *Functional Requirements for Authority Data* supplied the definitions for FRAD.[7] FRSAD's definitions are derived from the *Functional Requirements for Subject Authority Data's* third chapter.[8] Entity definitions used in LRM are from *IFLA-Library Reference Model.*[9] The RDA entity definitions are from the *RDA Toolkit* Beta site, which is available via subscription to the RDA Toolkit.[10] At the time of this writing, the RDA

Table 1. Work.

Entity	FRBR	LRM	RDA	BIBFRAME
Work	A distinct intellectual or artistic creation	The intellectual or artistic content of a distinct creation	A distinct intellectual or artistic creation, that is, the intellectual or artistic content	Resource reflecting a conceptual essence of a cataloging resource

Table 2. Expression

Entity	FRBR	LRM	RDA	BIBFRAME
Expression	The specific intellectual or artistic form that a work takes each time it is realized	A distinct combination of signs conveying intellectual or artistic content	An intellectual or artistic realization of a work in the form of alpha-numeric, musical or choreographic notation, sound, image, object, movement, etc., or any combination of such forms	Work has property expressionOf, Work that the described Work is an expression of

Toolkit is still being restructured, and a final version has not been released. Lastly, the BIBFRAME entity definitions are from the BIBFRAME 2.0 site, in the Vocabulary List View.[11] A discussion of each compared entity follows the corresponding table.

Res and Thema

Before discussing the first shared entity of the models, it should be noted that LRM introduced the entity *"Res."* *"Res"* is much like another word for entity. It covers all entities in LRM, is the top level, and holds the model together. The definition states, "Res is a superclass of all the other entities that are explicitly defined, as well as of any other entities not specifically labelled."[12] FRSAD introduced the concept of *"Thema"* and defined it as "Any entity used as a subject of a work." With LRM, the entity was generalized to include "any entity in the universe of discourse" and renamed *"Res"* ("thing" in Latin).[13] RDA uses the term "universe of human discourse" in its definition for RDA Entity, its superclass of all entities, making it clear that RDA Entity is its equivalent for *"Res."* BIBFRAME has no equivalent for *"Res"* or *"Thema."*

Work

Table 1 shows that for the entity "Work," a major change in LRM from the original FRBR definition is the addition of "content of" in the LRM definition. This wording makes the definition more specific. The "Work" definition now encompasses the content of the creation, not the creation itself. This idea has been carried over in the RDA definition, "a distinct intellectual or artistic creation, that is, the intellectual or artistic content." Both LRM and RDA retain the FRBR idea of "a distinct creation," making it apparent

that a "Work" must be unique and distinct from others. FRAD and FRSAD both cite the FRBR definition. The language differs considerably, however, from the BIBFRAME definition. The BIBFRAME phrase "resource reflecting a conceptual essence" combines the concept of "Work" and "Expression." As seen in the online BIBFRAME documentation, the FRBR concept of "Expression" maps to the BIBFRAME concept of "Work," therefore the two are one entity in BIBFRAME. The overview of the model defines a Work more clearly as "the highest level of abstraction, a Work, in the BIBFRAME context, reflects the conceptual essence of the cataloged resource: authors, languages, and what it is about (subjects)."[14] Because BIBFRAME is intended for the transition of MARC21 format to a bibliographic description format grounded in linked data techniques, this combination allows an easier transwsition from a format not based on WEMI.[15]

Expression

As shown in table 2, the entity "Expression" has been simplified from the original FRBR definition to its recent LRM definition. While the LRM does not cite the term "Work" in its "Expression" definition, it explains that the entity is "A distinct combination of signs conveying intellectual or artistic content." This part of the definition could read as "signs conveying a 'Work.'" The RDA Toolkit Beta site uses the same phrase, "in the form of alphanumeric, musical, or choreographic notation, sound, image, object, movement, etc., or any combination of such forms." The RDA definition provides a list of various forms in which the "Expression" can be produced, perhaps to convey the breadth of possible resources that can be described as "Expressions." While the new LRM definition is not as enumerative as the original FRBR definition, it focuses on "any combination of such

Table 3. Manifestation

Entity	FRBR	LRM	RDA	BIBFRAME
Manifestation	The physical embodiment of an expression of a work	A set of all carriers that are assumed to share the same characteristics as to intellectual or artistic content and aspects of physical form. That set is defined by both the overall content and the production plan for its carrier or carriers.	A physical embodiment of an expression of a work	Called Instance, a resource reflecting an individual material embodiment of a work

Table 4. Item

Entity	FRBR	LRM	RDA	BIBFRAME
Item	A single exemplar of a manifestation	An object or objects carrying signs intended to convey intellectual or artistic content	A single exemplar or instance of a manifestation	Single example of an instance

forms." Essentially, the meaning is the same and emphasizes the broadness that an "Expression" can take. As shown in the table, BIBFRAME combined "Work" and "Expression" into one entity. Both FRBR and LRM explain that an "Expression" is a "Work" that has been "realized." BIBFRAME operates under the assumption that all "Works" being cataloged have been realized, thus the "Expression" is not needed in BIBFRAME as a separate entity.

Manifestation

The RDA Steering Committee decided to retain the original FRBR definition of a "Manifestation," the physical embodiment of an "Expression" of a "Work," in the RDA Toolkit. In contrast, the LRM completely reworked the definition to emphasize the carrier concept, as shown in table 3. Rather than calling it a "physical embodiment," the language defines all carriers that share the same characteristics regarding intellectual or artistic content and aspects. A positive aspect of this LRM definition is the reminder to catalogers that a "manifestation" will share characteristics of the content with other manifestations of the same work.

Not only has BIBFRAME reduced the WEMI model to three entities, it has redefined "Manifestation" as an "Instance," "a resource reflecting an individual material embodiment of a Work," as shown in the table above. The BIBFRAME website clarifies information recorded for an instance includes publisher, place and date of publication, and format, for example.[16] It also clarifies the differences in a print and an electronic reproduction. As McCallum explains, "in the MARC environment it was common to try to describe on one record the manifestation and all the different carriers for it. With the BIBFRAME model the expectation is that major differences in carriers, such as print and electronic, would be separate Instances of a Work

and characteristics of each can then be clearly recorded in the Instance descriptions."[17]

Item

The RDA Toolkit and BIBFRAME have retained the original FRBR definition, with minor differences, for the entity "Item." as shown in table 4 above. The LRM definition, however, is "a physical object carrying signs resulting from a production process and intended to convey intellectual or artistic content." The scope notes clarify that, "an item exemplifying a manifestation normally reflects all the characteristics that define the manifestation itself." Therefore, the meaning of "Item" has not changed much from FRBR. Both FRBR and LRM explain that an "Item" can be more than one physical object, such as a multi-volume monograph. While they both define an "Item" as a physical object, LRM makes clear in its scope notes for the relationship between a "Manifestation" and an "Agent" distributing it, "items can be made available through the traditional distribution processes for physical items, or by making electronic items available for download, streaming, etc."[18] Referring back to the table, BIBFRAME also defines an "item" as physical or electronic, and "it reflects information such as its location (physical or virtual) shelf mark, and barcode.[19]

Agent

In RDA, an "agent" is a person or group of persons capable of acting as a unit, as shown in table 5. RDA also follows the LRM hierarchy, by defining "Agent" as a super-type, with "Person" and "Collective Agent" being sub-types. BIBFRAME defines an "Agent" as a person or an organization with a role. It also lists Family, Organization, Jurisdiction, and Meeting as subclasses. Therefore, although "Agent"

Table 5. Agent

Entity	FRBR	LRM	RDA	BIBFRAME
Agent	not found in FRBR	An entity capable of deliberate actions, of being granted rights, and of being held accountable for its actions	A person, family, or corporate body	Entity having a role in a resource, such as a person or organization

Table 6. Person

Entity	FRBR	LRM	RDA	BIBFRAME
Person	an individual	An individual human being	An individual human being who lives or is assumed to have lived	Individual or identity established by an individual (either alone or in collaboration with one or more other individuals

Table 7. Collective Agent

Entity	FRBR	LRM	RDA	BIBFRAME
Collective Agent	Not found in FRBR	A gathering or organization of persons bearing a particular name and capable of acting as a unit	A gathering or organization of persons bearing a particular name and capable of acting as a unit. A collective agent includes a corporate body and a family.	Not found in BIBFRAME

did not exist in FRBR/FRAD/FRSAD, it plays the same important role in LRM, RDA, and BIBFRAME. While definitions differ in wording, in all three "Agent" is an entity consisting of all the related subclasses. However, these subclasses differ in all three.

With FRBR, Work, Expression, Manifestation, and Item are called Group 1 entities. Group 2 entities were Person and Corporate Body. Group 3 were "Concept," Object, Event, Place.[20] FRAD added the entity "Family" to the Group 2 entities.[21] FRSAD introduced two new entities, Nomen and Thema.[22] When IFLA consolidated FRBR, FRAD, and FRSAD into one model, this hierarchy was not retained. LRM has three levels, with *Res* at the top level. The second level is comprised of Work, Expression, Manifestation, Item, Agent, Nomen, Place, and Timespan. Group 3 entities are on the same level as Group 1. The Group 2 entities are Person and Collective Agent and are subclasses of "Agent." "Collective Agent" encompasses the former FRAD entities Family and Corporate Body. The "Agent" definition in LRM asserts various properties, such as "capable of deliberate actions, of being granted rights and of being held accountable for its actions."[23]

Person

In FRBR and its authority models, a "Person" is an individual, living or dead, or a persona or identity "established

or adopted by two or more individuals." Both FRBR and FRAD cited the pseudonym Ellery Queen as an example of a "person," even though Queen was the pseudonym used by two cousins. However, in LRM and RDA, as shown in table 6, Ellery Queen is now a "Collective Agent" because a "Person" is an individual human being. In BIBFRAME, Queen is a "Person" under its definition, which includes individuals, but also identities established either alone or in collaboration with others. In FRAD, it is explained that fictional characters may be Persons, Families, Places, etc. according to some cataloging rules but are Concepts according to others.[24] The cataloging rules to which FRAD refers are AACR2 (Anglo-American Cataloging Rules, revised). LRM changed this ambiguity, eliminating fictional characters such as Kermit the Frog from its definition. In LRM, a fictional character is only a *Res*, which lists fictional characters in its scope notes. *Res*, as a superclass, covers "any other entities not specifically labelled."[25] RDA, by using the phrase "individual human being who lives or is assumed to have lived," excludes fictional characters and real animals or other non-humans. BIBFRAME enables catalogers to use their own judgement by using the original FRBR definition.

Collective Agent

FRBR originally defined a corporate body as "an organization or group of individuals and/or organizations acting as a

Table 8. Nomen

Entity	FRBR	LRM	RDA	BIBFRAME
Nomen	In FRAD, Name is a character, word, or group of words and/or characters by which an entity is known	An association between an entity and a designation that refers to it	A designation that refers to an RDA entity. A designation includes a name, title, access point, identifier, and subject classification codes and headings.	Not found in BIBFRAME

unit," as shown in table 7. The second subclass of "Agent" in LRM is "Collective Agent." LRM's definition of "Collective Agent" is like the FRBR definition for Corporate Body, but it further defines the entity as "a gathering or organization of persons bearing a particular name," emphasizing the group acting as a unit is a named group. What distinguishes a "Collective Agent" from a gathering of people is that the name "must be a specific name and not just a generic description for the gathering."[26] While families and corporate bodies are no longer LRM entities, the scope notes for "Collective Agent" explains that they are specific types that "may be relevant in a particular bibliographic application."

This explanation is followed by RDA in its use of "Collective Agent." Its definition in the RDA Beta toolkit is similar to the LRM definition, but also defines the entity as an entity super-type with two entity sub-types, Family and Corporate Body. The RDA definition for Corporate Body requires the group of persons or organizations to be identified by a name, just as LRM does for "Collective Agent." The other sub-type, Family, matches the original FRAD definition.

Referring back to table 7, BIBFRAME differs completely from LRM and does not use "Collective Agent." In LRM, "Agent" has two subclasses, and has five in BIBFRAME. The first, "Person," has already been discussed in this paper. The other four, Family, Organization, Jurisdiction, and Meeting, are "Collective Agents" in LRM. BIBFRAME's definition of "Family" is the same as the definition first introduced in FRAD. The "Organization" entity is a match for the original definition created by FRBR. In its definition, BIBFRAME does not specifically state that the group acting as a unit must have a specific name, leaving room for the user's judgement, and the set of cataloging rules in use. The Jurisdiction entity is defined as a "legal or political unit administering a geographic area." The last sub-type, Meeting, is a "gathering of individuals or representatives of various bodies for the purpose of discussing and/or acting on topics of common interest." Considering that LC created BIBFRAME with its own collections in mind, it is apparent they have decided Jurisdiction and Meeting are relevant to its bibliographic application.

MARC format has defined fields for Meeting (111, 611, 711, 811), while Jurisdiction was an indicator under the Corporate Name fields. By defining the two as sub-types, it allows the retention of these specific agents when converting from MARC.

Nomen

In FRAD, the definition for name initially described only characters, words, or a group of words and/or characters used to identify an entity. In FRSAD, Nomen is defined as "any sign or sequence of signs (alphanumeric characters, symbols, sound, etc.) that a *thema* is known by, referred to, or addressed as." This is much broader than the original definition for "Name." In LRM, the definition is simply "an association between an entity and a designation that refers to it." By not defining the signs or sequence of signs for the designation, the LRM definition is the most inclusive.

RDA has also changed the definition to both broaden it and make it more specific, adding the following statement, "A designation includes a name, title, access point, identifier, and subject classification codes and headings." Hence, any identifier can be a "Nomen." However, BIBFRAME does not seem to have a corresponding entity to "Nomen." According to the LRM model, "A nomen associates whatever appellation (i.e., combination of signs) is used to refer to an instance of an entity found in the bibliographic universe with that entity. Any entity referred to in the universe of discourse is named through at least one nomen."[27] Therefore, by this definition, the "Nomen" expresses the relationship(s) between a resource and the designation(s) associated with it. RDA and LRM both also clarify that "Nomen" is expressed by a nomen string, "the combination of signs that forms an appellation associated with an entity."[28] BIBFRAME is the actual implementation of RDA, LRM and/or other cataloging models. To label a Work with a nomen string and then label the nomen string as a "Nomen" in BIBFRAME would be redundant.

Place

Concept, Object, Event, and Place are the FRBR Group 3 entities. Of the four, "Place" is the only one with a counterpart in LRM, although the original "Place" entity has been deprecated. With FRBR, a "Place" is "a location," as seen

Table 9. Place

Entity	FRBR	LRM	RDA	BIBFRAME
Place	a location	A given extent of space	A given extent of space	Geographic location or place entity associated with a resource or element of description

Table 10. Timespan

Entity	FRBR	LRM	RDA	BIBFRAME
Timespan	Not found in FRBR	A temporal extent having a beginning, an end and a duration	A temporal extent having a beginning, an end and a duration	Called Temporal, a chronological period

in table 9. This definition encompasses a range of locations: "terrestrial and extra-terrestrial; historical and contemporary; geographic features and geo-political jurisdictions." It also may include fictional places, as explained earlier in the entity "Person." FRBR allows fictional places to be "Places" or "Concepts." However, in LRM, a "Place" is "the human identification of a geographic area or extent of space." While both FRBR and LRM allow a "Place" to be on Earth or extra-terrestrial, LRM eliminates imaginary, legendary or fictional places from its definition. RDA and BIBFRAME give brief definitions of "Place," and do not describe what constitutes a "Place." In RDA a "Place" is "a given extent of space," while in BIBFRAME it is a "geographic place."

Timespan

"Timespan," an entity not found in FRBR, has a shared definition in LRM and RDA, as shown in table 10. Their definition, "a temporal extent, having a beginning, an end, and a duration," specifies that "Timespan" cannot be recorded as open-ended. BIBFRAME has named the entity "Temporal," with the simple definition "a chronological period," a less specific but very broad definition that could be used to describe any sort of length of time associated with a resource.

Other Entities

As previously explained, not all entities in FRBR/FRAD/FRSAD were included in the transition to LRM, and as a result, in RDA. Most of these entities were, as LRM describes, deprecated. LRM defines deprecated as "The entity, attribute or relationship is eliminated from LRM (i.e. it is unneeded, or reconceptualized)."[29] The FRBR Group 3 entities Concept, Object, and Event have all been deprecated. Place was redefined. FRAD introduced the entities Identifier and Controlled Access Point. Both have been deprecated in LRM, though they can be used as subclasses

of "Nomen." Two other FRAD entities, Rules and Agency, are out of scope for LRM. Out of scope entities are "outside the functional scope of LRM, and so not included at all. It might be conceptually valid, but in a model with a broader scope."[30]

The entities shown in BIBFRAME are only the entities relevant to the main LRM and RDA conceptual models. The BIBFRAME class and property list is extensive and the purpose of this study was to focus on BIBFRAME's implementation of these models. While BIBFRAME has entities relating to FRBR's deprecated entities, they are not covered here.

Relationships Among Entities

Entities are only one part of the entity-relationship model. Carlyle gives the following explanation of an entity-relationship model: "A simplified explanation of the structure stipulated by an ER model is that three kinds of things are allowed in it: *entities, attributes,* and *relationships. Entities* are things, either physical or abstract. Thus, an entity can be virtually anything: *relationships* are interactions among entities and *attributes* are properties or characteristics of either entities or relationships."[31] Table 11 illustrates the two-way relationships possessed by all WEMI entities.

The LRM provides the following example of Agent relationships: Agent (isA) PERSON, PERSON (isA) AGENT, and (LRM-R5i) AGENT 'created' WORK. This sequence implies the more specific relationship: PERSON 'created' WORK. These LRM relationships also seem to have been designed with the classic "entity-relationship-entity" format to allow for production of RDF triples. This observation is based on the structure of entity relationships as described in both the LRM and BIBFRAME. Figure 1 below is an example of a relationship between entities that would produce a triple in RDF.

"It is important to note that while relationships are declared between entities, in reality they are established

Table 11. WEMI Entity Relationships in FRBR

Entity	Attribute	Relationship
Work	Is realized through	Expression
Expression	Is embodied in	Manifestion
Manifestion	Is exemplified by	Item
Item	Is exemplar of	Manifestation
Manifestion	Is embodiment of	Expression
Expression	Is realization of	Work

and exist between instances," according to the IFLA LRM.[32]

BIBFRAME describes this Agent relationship differently, as an association, thus:

A BIBFRAME Agent may be associated with a BIBFRAME resource (e.g. Work) through some role, like author, illustrator, or editor.

Role Association Expressed as a Contribution

Property bf:contribution and Class bf:Contribution
The property bf:contribution has expected value a bf:Contribution, which pairs an agent with a specific role. For example, Role is illustrator, and the association is expressed as a Contribution.[33]

Therefore, the Agent's bf:Contribution is illustrator. This sequence recalls the entity-relationship definition, consisting of entities, relationships, and properties.

The RDA Toolkit Beta version offers a relationship matrix for each of the entities. The relationship matrix for Agent provides the instruction, "To record an association between this entity and a related entity, use a relationship element that is sufficiently specific to meet the needs of the agency creating the data."[34] It includes a listing of possible relationships, with a description and example of each. An example of an RDA Agent to Work relationship is "author of." Other potential relationships listed in the matrix are "composer of "work of" or "director of." Several of the listed relationships have sub-relationships that are more specific. "Creator of," for example, has twenty-three sub-relationships from which to choose, such as "photographer of work of" or "remix artist of." The cataloger can specify the Work's relationship to an "Agent" using one of these. Like BIBFRAME, these relationships are intended to be used in the production of metadata, including but not limited to MARC records, in which the subfield e within a 1XX or 7XX field would be used to specify the type of relationship such as "Creator of."

Each entity can have numerous relationships linking it to others, creating a network that, when a URI is defined
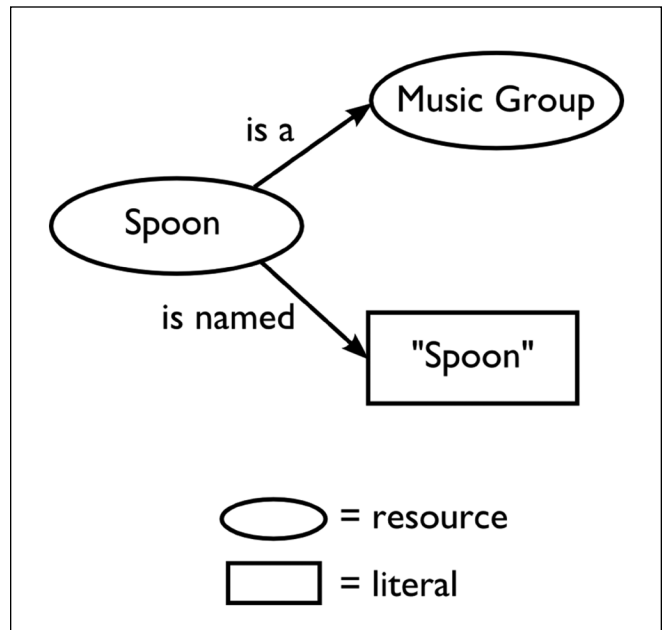
Figure 1. RDF Triple

for each entity and relationship, becomes linked data. Interestingly, each of the models describes these relationships differently. FRBR explains how the entities can have relationships with each other with explanatory charts. This approach was perhaps used because the entity relationship model was not as well known when FRBR was released in the late 1990s. LRM and BIBFRAME offer examples of the resulting RDF triples for each relationship, whereas RDA includes lists (relationship matrixes) of relationships possible for each entity to be used for MARC records and other types of metadata production.

Conclusion

More than twenty years have passed since IFLA issued its final report on FRBR, creating its entity-relationship model. Because FRBR was intended to define requirements for a minimal-level bibliographic record, it was followed by FRAD and FRSAD to address name authority and subject authority data respectively. These models took over a decade to be finalized. The consolidation of these models led to the next step of evolution for the WEMI model, LRM. The differences between FRBR, FRAD, FRSAD, and LRM can be explained by the differences in each model's scope. LRM does not distinguish between data traditionally stored in bibliographic, holding, or name and subject authority records, instead "all of this data is included under the term bibliographic information and as such is within the scope of the model."[35] The goal of the LRM as a conceptual model

is to cover a broad scope, which can also explain its differences from RDA and BIBFRAME.

In 2016, LC introduced BIBFRAME 2.0, to follow up its initial model. Both versions of BIBFRAME were introduced after FRBR and its companions but before LRM. This timing only partly explains its differences from LRM. BIBFRAME, while also concerned with bibliographic description, has the purpose to aid in the transition from MARC 21 formats to formats that are more linked data-friendly. This purpose can explain the other differences.[36] This paper discusses some, but not all, of the entities found in BIBFRAME. The most important distinction between BIBFRAME and the other entity-relationship models is its simplification of the WEMI model. This difference was perhaps intended for an easier transition from MARC 21. Additionally, BIBFRAME is not concerned with a "Work" until it has become an "Expression."

The original version of RDA was released in June 2010, and it did not include RDA entities. In 2017, the RDA Toolkit Restructure and Redesign (3R) Project began, with one of its goals to implement LRM in RDA. Because the RDA Toolkit Beta version was modeled after LRM, it resembles LRM more than any of the other models examined. Yet RDA also has a more specific goal than LRM's general overview of bibliographic information. RDA's purpose is to enable the creation of "library and cultural heritage metadata that are well-formed according to international models."[37]

Despite these differences in purpose and scope, all studied models share the common goal to help users to Find, Identify, Select, and Obtain the resources they need. These user tasks were first introduced in FRBR. While the WEMI model continues to evolve and be fine-tuned by LRM and implementation models like BIBFRAME and RDA, these user tasks have remained.

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