

FRBRoo, the IFLA Library Reference Model, and now LRMoo: a circle of development

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Abstract:

IFLA's conceptual models for bibliographic information are maintained in two forms, entity-relationship modelling and object-oriented modelling. The two formalisms have different strengths and purposes, but the choice does not have a crucial effect on the model itself. As the models have developed in phases, the insights gained in one round of development have regularly informed and influenced the next development. This paper illustrates the influences and adaptation of ideas using examples from the most recently approved models: FRBRoo version 2.4 (2016) and IFLA LRM (2017), continuing to current work to create LRMoo.

Keywords: IFLA Library Reference Model, IFLA LRM, CIDOC Conceptual Reference Model, FRBRoo, LRMoo

1. Introduction

IFLA's original conceptual model, FRBR, was developed as an entity-relationship model, as were the FRAD and FRSAD models that joined it. The IFLA Library Reference Model (IFLA LRM), approved in August 2017, was developed to consolidate the three existing models in the FR family of conceptual models, FRBR, FRAD, and FRSAD, into a single unified reference model that covers all aspects of bibliographic and authority information. Still in an entity-relationship framework, the IFLA LRM model is a high-level conceptual model and operates at a greater level of generality than the preceding models.

The object-oriented member of the family of models, FRBRoo, whose first version corresponded only with the original FRBR model (referred to in this context as FRBR(er)),

was later expanded to include FRAD and FRSAD, starting from version 2. The FRBRoo model was designed as an object-oriented version of the FRBR model functioning as a compatible extension to the CIDOC Conceptual Reference Model (CIDOC CRM), the ontology developed and maintained by the museum community.

2. Influence of CIDOC CRM on IFLA LRM

The development work that gave rise to the FRBRoo model was undertaken during meetings of the CIDOC CRM Special Interest Group (SIG), the group mandated to maintain the CIDOC CRM model, and following its working practices. The core CIDOC CRM SIG members who participated in FRBRoo development, along with representatives mandated by the FRBR Review Group, became known as the International Working Group on FRBR and CIDOC CRM Harmonisation, and the same group has alternatively been referred to as the Working Group on FRBR/CRM dialogue by the FRBR Review Group.

This close working relationship with experts in the CIDOC CRM model has meant that FRBRoo was closely integrated with the CIDOC CRM, allowing insights from CIDOC CRM to be incorporated into the object-oriented model. However, it is important to remember that the direction of model development has always involved two stages. First, the creation of an entity-relationship model of the library domain by working groups composed of librarian experts. Then, its transposition to a harmonised object-oriented model developed jointly with the museum community.

These stages were applied for the first time to produce FRBRoo version 1 (completed in 2009) from FRBR, then again to produce FRBRoo version 2.4 (completed in 2015 and approved as an IFLA standard in 2016) from FRBR plus FRAD and FRSAD. The goal of rapidly expanding the initial version of FRBRoo into a model that included FRAD and FRSAD meant that a consolidation process was completed first within the object-oriented FRBRoo model. This process operated as a parallel and partly independent development from the consolidation process that led to the IFLA LRM model two years later. Although the issues raised through that process informed the thinking of the Consolidation Editorial Group, the solutions adopted in FRBRoo version 2.4 did not predetermine the decisions ultimately taken in IFLA LRM.

Some of the areas of influence between the development of FRBRoo and IFLA LRM include the use of entity hierarchies, the concept of representativity, and modelling bibliographic identities.

2.1. Entity hierarchies

In the CIDOC CRM model the classes (entities) are organised in a superclass/subclass structure that allows the properties (equivalent to relationships and attributes) to be declared at the most general applicable class and yet also apply to all of its subclasses. FRBRoo also makes extensive use of subclasses and subproperties to streamline the model and avoid the repetition of properties.

In contrast, FRBR did not organise the entities into a hierarchy; all ten FRBR entities function independently as far as relationships are concerned. This had immediate consequences in the definition of the primary relationships. FRBR figure 3.2 depicts the four responsibility relationships each as linking one of the entities *work*, *expression*, *manifestation*, and *item* to both the *person* and the *corporate body* entities. The diagram does

this by showing the target of the relationships as an unlabelled box around both the *person* and *corporate body* entities. In establishing a namespace for the FRBR model, each responsibility relationship had to be declared separately for each combination of domain and range. For instance, the relationship *work is created by person* is frbrer:P2009 while *work is created by corporate body* is frbrer:P2007, and (added by FRAD) *work is created by family* is frad:P2020. In this way, what are really only four distinct relationships semantically, end up as 12 different formal declarations in linked data, obscuring the underlying pattern.

Similarly, FRBR figure 3.3 depicts the subject relationship as linking the entity *work* to boxes surrounding all ten of the FRBR entities, resulting in ten distinct namespace declarations (and an eleventh with the entity *family* as range), all for the same semantic relationship. In FRSAD the subject relationship is declared between *work* and the entity *thema*, adding a twelfth declaration to the combined namespaces. Although FRSAD appendix B (*Relationship of FRSAD with FRBR and FRAD*) describes the entity *thema* as a “superclass of all entities that can be subjects of a *work*” these FRBR entities are not entities declared in FRSAD, and this superclassing is not an official part of the FRSAD model.

IFLA LRM integrated the concept of hierarchical structure from CIDOC CRM/FRBRoo and adopted an enhanced entity-relationship framework which permitted the introduction of a simple entity hierarchy with three levels (shown in IFLA LRM table 4.1), taking the opportunity to reduce redundancy in the declaration of attributes and relationships. The top level entity LRM-E1 *res* is the superclass of all other entities in the model. It takes the role of the FRSAD entity *thema* in the subject relationship, serving as the range of the LRM-R12 **has as subject** relationship, which only needs to be declared once as it also applies to all subclasses of LRM-E1 *res*. At the lower hierarchical level, the LRM-E6 *agent* entity is the superclass of the two entities LRM-E7 *person* and LRM-E8 *collective agent*. This is particularly significant in streamlining the attributes and relationships of these entities which, with few exceptions, can be declared at the level of LRM-E6 *agent*.

2.2. Representativity

In FRBR all *expressions* of a given *work* have equal status, and all attributes of these *expressions* are equal. There is no mechanism to single out an “original” *expression*, nor to flag any of its attribute values as significant. This has led to considerable discussion as it would seem intuitive that the original language of a textual *work*, or the original key of a musical composition, would be of interest to users.

In modelling the process by which a cataloguer assigns a uniform title to a *work*, FRBRoo version 1.0 introduced the idea that a *manifestation* may be determined to be representative of a specific *expression*, and that an *expression* may be determined to be representative of the *work*. This allows features of the representative *manifestation*, such as its title proper, to be used as the title for the *expression* embodied in that *manifestation*. Then in the next process of abstraction, features of that *expression*, such the language of its text, can then be used in devising the title for the *work*. FRBRoo formally models this process using two classes, F41 Representative Manifestation Assignment and F42 Representative Expression Assignment, both subclasses of the CIDOC CRM class E13 Attribute Assignment. Properties R40 **has representative expression (is representative expression for)** and R41 **has representative manifestation product type (is representative manifestation product type for)** link the respective *works-expressions-manifestations*.

In IFLA LRM, this notion of representativity was introduced to provide a way to identify those *expression* attributes that are significant in identifying the *work*, such as those generally

used in assigning a preferred access point for the *work*. The first proposed mechanism, found in the 2016 world-wide review draft, involved defining an attribute of the *expression* that would flag an *expression* as being representative of the *work*, automatically meaning that the attributes of that *expression* would be viewed as being values that are significant for the *work*. The inspiration for this modelling technique can clearly be seen in the FRBRoo model described above.

However, responses to the world-wide review pointed to practical and conceptual difficulties with the identification of a specific representative *expression* for a *work* all of whose attributes would be granted this special status. In the approved IFLA LRM model, the ability to identify attribute values that are significant in characterizing a *work* was retained, but instead modelled via a special attribute of the *work*, LRM-E2-A2 Representative Expression Attribute, which can be subtyped to provide for the identification of relevant attributes depending on the category of the *work*. In this case, IFLA LRM ultimately moved beyond the FRBRoo technique and adopted an original solution to the issue of representativity.

2.3. Representing bibliographic identities

FRAD was the first model to consider the issue of bibliographic identities or personas that may be adopted by individuals or groups when producing *works*. FRAD integrated these personas into the definition of the entity *person*, resulting in a definition of that entity incompatible with the definition of *person* from FRBR. FRAD also innovated in modelling *names*, *identifiers* and *controlled access points* as entities in their own right, rather than considering them attributes of other entities, also establishing a general appellation relationship. The FRSAD model also separated the entity *thema* (any entity used as a subject of a *work*) from the entity *nomen* which comprised all forms of appellations.

FRBRoo version 2.4, starting from the FRSAD definition of *nomen*, developed the view of bibliographic identities as *nomens* restricted to specific contexts of use, attested to in *nomen* use statements found in reference sources. Formally, FRBRoo added classes and properties to explicitly link an entity with any *nomen* used to refer to it, as well as to account for any assignment activities. The class F35 Nomen Use Statement comprises formal statements, such as those found in authority records, that link a *nomen* with its meaning. To account for the adoption of a name by a person in specific circumstances or during particular time periods, FRBRoo defined the classes F52 Name Use Activity and F51 Pursuit. This permitted continued interoperability of the basic *person* entity with the E21 Person class in CIDOC CRM. Carefully accounting for *nomens* and their properties was the single issue resulting in most of the expansion of FRBRoo into version 2.4.

Much of this insight has been adapted in IFLA LRM. Bibliographic identities are modelled as *nomens* assigned to actual *agents*. The attributes of the LRM-E9 *nomen* entity include LRM-E9-A5 Context of Use and LRM-E9-A6 Reference Source. However, IFLA LRM has developed a more carefully nuanced definition of the *nomen* entity, defining it as the “association between an entity and a designation that refers to it” and defining the attribute LRM-E9-A2 Nomen String to store the actual signs that make up the appellation. As a reified relationship, LRM-E9 *nomen* is in a similar role as the F35 Nomen Use Statement.

3. From IFLA LRM to LRMoo

Now that IFLA LRM is approved, the harmonisation process with the CIDOC CRM model has begun anew. Work has already begun to review FRBRoo version 2.4 to bring it into

conformance with IFLA LRM, thus maintaining this important aspect of cross-community compatibility. The first steps towards bringing the object-oriented model into conformity with IFLA LRM took place in April 2017, at the Joint Meeting of the CIDOC CRM Special Interest Group and FRBR/CRM Harmonisation Working Group, and has continued at meetings in October 2017, January 2018 and May 2018. Since the entity-relationship model was given a new name, the decision was taken at the October 2017 meeting of the CIDOC CRM Special Interest Group to also rename the object-oriented model, which will be known as LRMoo.

In the same way that developing IFLA LRM was much more than a simple editorial task, transferring it into the object-oriented framework is also providing an opportunity to critically re-assess all aspects of FRBRoo. The review, while not changing the nature of the model, will surely permit some simplifications and possibly lead to a “core” model for implementation. This work is ongoing, with a projected completion of a draft model definition text by the end of 2018.

When FRBRoo was developed it was the first extension to CIDOC CRM. One of the design principles was that the FRBRoo model would be self-contained and also clearly reflect in itself the FRBR(er) model. As a result, classes were declared in FRBRoo for FRBR entities that were considered exactly equivalent to CIDOC CRM classes. Among these were: F6 Concept, equal to E28 Conceptual Object; F7 Object, equal to E18 Physical Thing; F8 Event, equal to E4 Period; F9 Place, equal to E52 Place; F10 Person, equal to E21 Person; F13 Identifier, equal to E42 Identifier. In most of these cases, the scope notes for the FRBRoo class consisted of an abridged version of the corresponding CIDOC CRM class as of a specific version of CIDOC CRM. While this reduced the need for users of FRBRoo to consult the CIDOC CRM documentation, it carried the potential of inconsistency if updates to the CIDOC CRM scope notes did not get carried over to FRBRoo. In recent years, the CIDOC CRM family has grown to include several other extensions. It is now recognized that these cannot all duplicate core CIDOC CRM classes in this way. The new policy is to avoid duplication of CIDOC CRM classes in the extensions. What this means for LRMoo is that IFLA LRM entities such as LRM-E7 *person*, LRM-E10 *place* and the new entity LRM-E11 *time-span* are now mapped directly to the corresponding CIDOC CRM classes E21 Person, E52 Place and E53 Time-span. The previously defined FRBRoo classes F9 Place and F10 Person are deprecated.

The main focus in developing LRMoo is on streamlining the *work-expression-manifestation-item* chain. Particularly the group of *work* classes (F14 Individual Work, F15 Complex Work, F16 Container Work) that caused some confusion and consequently resulted in non-interoperable interpretations. The stricter definitions and scope notes of IFLA LRM enable a better understanding of the underlying logic and simplify the development of mappings.

4. The influence on CIDOC CRM

FRBRoo has in the past influenced and enhanced aspects of CIDOC CRM. A few examples stand out. The distinction between a *work* (an abstract intellectual or artistic creation) and an *expression* (the fixing of this creation in a sequence of signs) was generalized and brought into CRM already in version 4.2.5 (May 2008) through the declaration, as subclasses of E28 Conceptual Object, of the classes E89 Propositional Object (superclass of F1 Work) and E90 Symbolic Object (superclass of F2 Expression).

FRBRoo (unlike FRBR(er)), distinguishes between *manifestations* consisting of a single *item*, class F4 Manifestation Singleton, and published, mass-produced *manifestations*, class F3 Manifestation Product Type. A Manifestation Product Type is the set of characteristics that define a specific publication, specifying those features that all *items* of that *manifestation* should display. However, all industrial or mass-produced products relate to an underlying product type, not only publications. As a result, in December 2016 the more general class E99 Product Type was accepted for CIDOC CRM and was first published in version 6.2.2 (2017). E99 Product Type allows the concept of type and exemplar to be applied to any sort of E22 Man-Made Object that is created through a process that is meant to produce multiple identical copies.

While the concept of appellations and identifiers has always been present in CIDOC CRM through the class E41 Appellation and its subclass E42 Identifier, a number of specializations of appellation were defined by the type of thing identified by the appellation. For instance, classes E44 Place Appellation, E49 Time Appellation, E75 Conceptual Object Appellation, and E82 Actor Appellation were defined to name, respectively, instances of E53 Place, E52 Time-span, E28 Conceptual Object and E39 Actor. However, experience working with the *nomen* model from FRBRoo 2.4, led to a review of the specialization of appellation types. At the December 2016 meeting it was decided to deprecate the E82 Actor Appellation class. This decision was influenced by the understanding that there is no innate form of a name that means it is for an actor, this is entirely governed by usage.

This cycle of influence between models will likely continue. So far the work on LRMoo had led to a critical examination of intention behind the descriptions of long-standing CIDOC CRM classes relating to agents, particularly the E74 Group class. In the mapping between IFLA LRM and LRMoo, a more careful distinction is being made between an actual E74 Group (currently viewed as a superclass of LRM-E8 *collective agent*) and people sharing one or more specific characteristics, such as an intended audience.

As the PRESSoo model is an extension based on both FRBRoo version 2.4 and CIDOC CRM, the change from FRBRoo to LRMoo will inevitably lead to PRESSoo revision. One possible impact relates to the Z9 Storage Unit class in PRESSoo. In the discussion of LRMoo, “promoting” the Z9 class from PRESSoo into LRMoo is an option being considered, which would mean that PRESSoo would no longer need to declare that class.

Conclusion

The models need to be tested in real applications and since IFLA LRM is a very general and high-level model, extensions and refinements will need to be developed. These implementations will be the real test of the model – and possible incentive to develop LRM further, thus starting a new cycle of developments.

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