IFLA's Conceptual Models: Impact and Evolution

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Abstract:

FRBR, FRAD and FRSAD, the three conceptual models developed by IFLA, have influenced the way in which communities around the globe perceive, understand and model the bibliographic universe. The sustained interest in these three conceptual models has led to their continuing evolution. This paper will look at two areas of development: harmonization with other cultural heritage communities to support data interoperability; and consolidation or bringing together the three FR models into one coherent and consistent model that will be easier to apply. These two modelling developments are designed to enable a more effective application of the modelling, especially as we move towards a linked data environment. They both take the original FRBR family of models as the starting point, and aim to keep the conceptual framework expressed in the three original models relevant and applicable in the current information environment. However, the two modelling developments are quite distinct and different from each other. This paper gives a brief overview of the impact of the FRBR family of conceptual models and describes the two modelling developments that grew out of the success of the original models.

Keywords:
FRBR, FRAD, FRSAD, $FRBR_{OO,}$ consolidated FRBR, consolidation, harmonization

Introduction

FRBR, FRAD and FRSAD[1], the three conceptual models developed by IFLA, have had a profound influence on our shared understanding of the bibliographic universe. The three models are often collectively called the FRBR family of conceptual models. These three

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[1] FRBR: Functional Requirements for Bibliographic Records, FRAD: Functional Requirements for Authority Data, FRSAD: Functional Requirements for Subject Authority Data.

models have shaped the development of cataloguing standards, such as RDA and REICAT, the design of databases, such as AustLit, Variations, Europeana, and aspects of WorldCat, as well as influencing the very way we speak about bibliographic information:

> Since the release of FRBR in 1998, there has been a growing reflection in the bibliographic community around the ideas it represents. FRBR has provided a unifying framework and a common terminology for discussion … [2]

The words "to FRBR-ize" and "FRBR-ization" have crept into our vocabulary. FRBR shaped IFLA's 2009 Statement of International Cataloguing Principles (ICP), as well as influencing revisions to the long-respected IFLA standard, the International Standard Bibliographic Description (ISBD). New initiatives involving bibliographic data in the library community begin with an acknowledgement of the role of the FRBR family of conceptual models. Even the first outline of the BibFrame model[3] looked to FRBR as a related library initiative and BibFrame is more focused on "expressing and connecting" data rather than creating and structuring that data.

When IFLA's conceptual models were published, they were well received by the library community and the concepts were analyzed, discussed and applied. In the process of being widely discussed and disseminated, two things happened: first, other communities noticed IFLA's conceptual models and the potential for data interoperability; second, we gained better insights into our models and saw ways to improve them. This has led to two major areas of development work in recent years. These can be characterized as harmonization and consolidation.

Harmonization entails bringing the library's conceptual models in line with CIDOC-CRM, the conceptual reference model of the international museum community (ICOM, International Council of Museums).[4] The original FRBR family of conceptual models were created using entity-relationship modelling. One of the results of this dialogue with the museum community has been an object oriented version of the FRBR family of conceptual models, known as FRBR$_{OO}$.[5]

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[2] Pat Riva, "Introducing the Functional Requirements for Bibliographic Records and Related IFLA Developments." *Bulletin of the American Society for Information Science & Technology* 33, no. 6 (2007): 9-10. http://www.asis.org/Bulletin/Aug-07/Riva.pdf

[3] *Bibliographic Framework as a Web of Data: Linked Data Model and Supporting Services*. Washington, D.C.: Library of Congress, November 21, 2012, pages 36-37. http://www.loc.gov/bibframe/pdf/marcld-report-11-21-2012.pdf

[4] CIDOC is ICOM's International Committee on Documentation. The CIDOC-CRM Special Interest Group reports to CIDOC and is responsible for developing the conceptual model for museum data, CIDOC CRM (CIDOC conceptual reference model).

[5] FRBR$_{OO}$ = FRBR object oriented. The full name of the model: FRBR: object-oriented definition and mapping from FRBR$_{ER}$, FRAD and FRSAD. http://www.ifla.org/files/assets/cataloguing/frbr/frbroo_v2.2.pdf

Consolidation entails bringing the three original FR models into one coherent, consolidated model that will be easier to apply. The consolidation process will generate a single entity-relationship library reference model.

This paper will begin with a brief look at the influence of the FRBR family of models in order to look at the ways in which the success of the IFLA models has led to their evolution. The paper will then review the two areas of development: harmonization and consolidation. These two modelling developments are separate and different, though closely related because they both take the original FRBR family of models as the starting point. They both aim to keep the conceptual framework expressed in the original three models relevant and applicable in an evolving information environment.

Influence of the FRBR family of conceptual models

In 1992, a study group was charged by IFLA's Standing Committee on Cataloguing to define the functional requirements for bibliographic records in order to achieve two objectives:

> The first is to provide a clearly defined, structured framework for relating the data that are recorded in bibliographic records to the needs of the users of those records. The second objective is to recommend a basic level of functionality for records created by national bibliographic agencies. (*FRBR* 2.1)

The Study Group's final report was approved in 1997 by IFLA's Standing Committee on Cataloguing and published in 1998. The development of a framework was one of two objectives, but it is that framework or conceptual model that has continued to be discussed, applied, and developed.

The cataloguing and metadata community around the world quickly recognized the usefulness and validity of the FRBR model, and began applying it in different studies, analyses, and applications involving bibliographic data. Evidence of the explanatory power of the model can be seen, for example, in the volume of writing about FRBR, and the number of projects that take FRBR as the theoretical starting point; many of these initiatives were cited in the FRBR bibliography. The extent of the bibliography demonstrates the level of acknowledgement and use of the model, and its positive reception in countries around the world. The volume of publications were not just a flurry immediately after the publication of the report, but continued to grow steadily over the ten years that the bibliography was actively updated. In 2008, updating was stopped: "Due to the increasingly large number of resources relating in some way to FRBR, the bibliography is not currently being actively updated."[6] The global evaluation of FRBR's significance can also be seen in the

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[6] *FRBR Bibliography* http://www.ifla.org/node/881

volume of translations. To date, there are twenty-one translations of the original FRBR report. The translations are listed at the IFLA website but were undertaken by national libraries, other organizations and/or individuals who felt that it was important to translate the document into their own language.

During these same years, IFLA was well aware of FRBR's impact. FRBR had fundamentally focused on bibliographic data. Immediately following FRBR's publication, a new IFLA working group was established to extend the FRBR model with a conceptual modelling of authority data: Working Group on Functional Requirements and Numbering of Authority Records (FRANAR). Their model, FRAD, was published in 2009. In 2005, working in parallel with FRANAR, a new IFLA working group was created to focus on the modelling of subject authority data: Working Group on Functional Requirements for Subject Authority Records (FRASAR). Their model, FRSAD, was published in 2010. Both of these models were also well received and each translated into several languages. By 2010, IFLA had published three conceptual models that became the underlying road map for understanding bibliographic and authority data around the world.

In light of FRBR's impact, IFLA's Standing Committee on Cataloguing created a working group in 2002 to provide ongoing support for the development and application of the model. The introduction to the 1998 FRBR report itself stated that the study was aiming to create an initial framework, "a basis for common understanding and further dialogue," and that it did "not presume to be the last word."[7] When the working group met in 2002, there was awareness that FRBR might not necessarily be the end point but a rather a launching point that would usher in further development: "the model may need to change over time." Thus, it was felt that "review group" status might be more appropriate. In 2003, the working group became the FRBR Review Group, whose main purpose was to maintain and develop the FRBR model. The terms of reference for the Review Group were expanded in 2009 to include the maintenance and development of all three models.[8]

Right from the beginning, there has been an expectation that the conceptual modelling would continue to grow and develop. In the past, there has been some work on developing the models. There was a significant amendment to FRBR in 2007, with the amendment of the definition of the expression entity. There has been work on improving the understanding of aggregate entities. The current work on the consolidation of the models represents a major step in development work, because the consolidation has required a

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[7] *Functional requirements for bibliographic records : final report* / IFLA Study Group on the Functional Requirements for Bibliographic Records. München : K.G. Saur, 1998. 1.3, page 5. Also available at the IFLA website: http://www.ifla.org/files/assets/cataloguing/frbr/frbr_2008.pdf

[8] FRBR Review Group. *Meeting report, Milan, Italy, August 25 and 26, 2009.* Section 4 – Terms of reference revision. The revision was proposed during the August meeting and approved during the autumn of 2009 in an email ballot (approved by both the Review Group and the Standing Committee on Cataloguing). http://www.ifla.org/files/assets/cataloguing/frbrrg/meeting_2009.pdf

remodelling in order to achieve consolidation. It was important to have conceptual models for bibliographic, authority, and subject authority data, and the task was made manageable by assigning different working groups to this task of analysis and abstraction. However, the articulation of three separate models created challenges for the actual application of the three models together because the models are not entirely coherent with each other. Thus, for example, the application of FRBR and FRAD in the development of the cataloguing standard RDA, led to the necessity of making certain interpretations in areas where FRBR and FRAD were not consistent with each other.[9]

From the early 2000s, there was also awareness that growth and development would not necessarily be just within the library community. At the first meeting of the FRBR Review Group, a strategic plan was developed that included the beginning steps towards interoperability with other communities:

> Promote dialogue with other information gathering communities that have developed or are developing conceptual models.[10]

In 2000, the European Library Automation Group held its annual conference in Paris with the theme "Libraries, Archives, Museums." During the event, the idea was informally expressed that there might be benefits if the library and museum community harmonized their conceptual models.[11] While FRBR was being developed in the international library community, the international museum community was developing its own conceptual model, the CIDOC CRM (CIDOC conceptual reference model). During 2001 and 2002, the CIDOC CRM community started to investigate the relationship between their model and FRBR.[12]

At the first series of meetings of the newly formed FRBR Review Group in 2003, the Working Group on FRBR/CRM Dialogue was created (sometimes also called the International Working Group on FRBR/CIDOC CRM Harmonisation). The group brings together representatives from the IFLA and ICOM communities and is co-chaired by the current chairs of the IFLA FRBR Review Group and the CIDOC CRM Special Interest Group. The first Joint FRBR/CRM Meeting was held in 2003. Harmonization grew out of recognition that each

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[9] Pat Riva and Chris Oliver. "Evaluation of RDA as an Implementation of FRBR and FRAD." *Cataloging & Classification Quarterly* 50 (5-7) 2012, 564-586. doi: 10.1080/01639374.2012.680848 http://dx.doi.org/10.1080/01639374.2012.680848

[10] FRBR Review Group. *Report on the FRRBR Working Group's Meetings, Berlin*, August 4 & 6, 2003, page 2. IFLA FRBR Review Group website: http://www.ifla.org/files/assets/cataloguing/frbrrg/meeting_2003.pdf

[11] FRBR: object-oriented definition and mapping from $FRBR_{ER}$, FRAD and FRSAD. p. 10 http://www.ifla.org/files/assets/cataloguing/frbr/frbroo_v2.2.pdf

[12] For example, see meeting minutes for the 1st CHIOS Meeting, Barcelona, 2001 and the 2nd and 3rd joined meetings of ISO/TC46/SC4/WG9 and CIDOC CRM SIG (2001, 2002). CIDOC CRM website: http://www.cidoc-crm.org/special_interest_meetings.html

community had developed significant and robust conceptual models and that there were potential benefits if interoperability could be established between these two important modelling initiatives.

From an early point, there was also awareness that building this interoperability would necessitate expressing the FRBR model using an object-oriented methodology. This has been achieved with the publication of $FRBR_{OO}$. $FRBR_{OO}$ harmonizes with and extends the conceptual reference model of the international museum community and provides the modelling for bibliographic entities, properties and relationships that was missing from their model.

The very success of the FRBR family of conceptual models has led to new work in developing the models to make them more useable and relevant in different environments. The success of FRBR generated the resolution to extend FRBR to authority and subject authority data, resulting in the development of three distinct, though highly inter-related, models. However, applications usually require reference to all three models and it is challenging to interpret the three consistently in the context of different applications. Thus, the next logical step is consolidation into one consistent model. Similarly, the recognition of FRBR's validity and usefulness was not confined to the library community. During the same time period, the museum community was also developing their own conceptual model, and there was recognition on both sides of the potential increase in value of each model if they could also interoperate and present a broader modelling of cultural heritage data.

Harmonization and $FRBR_{OO}$

Harmonization is the work undertaken to bring the IFLA conceptual models in line with the conceptual model of the international museum community in order to support data interoperability across the spectrum of library and museum data. Harmonization requires a careful mapping at both the level of meaning and the level of data structure, thus permitting valid and appropriate interoperability of data between these two communities. This work has resulted in the development of $FRBR_{OO}$, an interpretation of FRBR family of models using object-oriented methodology. FRBR, FRAD and FRSAD are entity-relationship models. The CIDOC-CRM uses an object-oriented approach, a different modelling technique that is well-suited for translating concepts and complex relationships into practical computer applications.

The Working Group on FRBR/CRM Dialogue, with representation from both the IFLA and ICOM communities, has been responsible for harmonizing the two models. Meetings on FRBR/CIDOC CRM Harmonization take place as part of the joined CIDOC CRM Special

Interest Group and ISO/TC46/SC4/WG9 meetings. The CIDOC CRM is a recognized ISO standard.[13]

Harmonization has enriched the conceptual models of each community. The CIDOC conceptual reference model (CRM) was designed to be an extensible model and the CIDOC CRM Special Interest Group has been working on extensions of the model to cover cultural heritage information in related domains, such as archaeology, scientific observation, geospatial information. $FRBR_{OO}$ is the extension for bibliographic data, thus increasing the breadth of the CIDOC CRM.[14] The CIDOC CRM has also been influenced by the development of $FRBR_{OO}$, for example, adding new depth to the modelling of intellectual creative activity, when the notion of "performance" was analyzed and incorporated into the model.[15]

This harmonization also promotes FRBR concepts. $FRBR_{ER}$, FRAD and FRSAD are high-level abstract models; $FRBR_{OO}$ is also abstract but is closer to an ontology that can be applied to real data. $FRBR_{OO}$ is more detailed and maps out the context for bibliographic data. It also supports the application of FRBR concepts in implementations because it can be used with object-oriented tools. $FRBR_{OO}$, by fitting into a modelling of a broad domain of cultural heritage data, can be integrated into actively used data models, such as EDM, Europeana Data Model, the model used for the Europeana portal.[16]

$FRBR_{OO}$ is an interpretation of FRBR family of models using object-oriented methodology. It is a mapping from the entity-relationship models to an object-oriented model that uses the same concepts and mechanisms as the CIDOC-CRM. $FRBR_{OO}$ makes explicit many entities and relationships that were implied in $FRBR_{ER}$. Many of the entities in $FRBR_{OO}$ also have explicit relationships to more generic entities, entities not limited to the domain of bibliographic data. For example, the bibliographic "nomen" is linked to the more generic CIDOC CRM "appellation." Finding the places where there are valid links from the entities/classes of one model to another allows for a meaningful mapping between the data models of different communities.

Harmonization entails the mapping of meaning between the models: does this entity in CIDOC-CRM mean the same thing as the entity in FRBR? Is it a narrower concept, a subclass

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[13] The earlier version of the CIDOC CRM is ISO 21127:2006. In December 2014, a new version (based on version 5.0.4 of the CIDOC CRM) became available: ISO 21127:2014. – CIDOC CRM website http://www.cidoc-crm.org/

[14] $FRBR_{OO}$ also has its own extension: $PRESS_{OO}$ which provides a detailed modelling of serials and other continuing resources; $FRBR_{OO}$ and $PRESS_{OO}$ together contribute a full modelling of bibliographic data for users of the CIDOC CRM. http://www.ifla.org/files/assets/cataloguing/frbr/pressoo_v0.5.pdf

[15] Martin Doerr, Patrick Le Boeuf, Chryssoula Bekiari. *$FRBR_{OO}$, a conceptual model for the performing arts*. Paper presented at 2008 Annual Conference of CIDOC Athens, September 15 – 18, 2008, p. 14. https://www.ics.forth.gr/_publications/drfile.2008-06-42.pdf

[16] *Final report on EDM- $FRBR_{OO}$ Application Profile Task Force*. http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/EDM_FRBRoo/TaskfoApplication%20Profile%20EDM-FRBRoo.pdf

of an entity in the other model? For example, the entity "corporate body" as understood in FRBR$_{ER}$ is an organization or group of persons and/or organizations identified by a particular name and acting as a unit. To bring this concept into a mapping coherent with CIDOC CRM, it must fit with the classes already in the CRM. There is no problem identifying that it will be within the "actor" class but it does not seem to have an equivalent among the existing subclasses. The CRM class "group" exists, but it is more general than the FRBR corporate body: any gatherings or organizations that act collectively or in a similar way due to any form of unifying relationship. The unifying relationship can include a set of ideas or beliefs held in common. Thus, people gathered together to participate in a peace protest at a given time and place are considered an example of the CRM "group" class. So "group" is broader in meaning than the FRBR corporate body. The CRM "legal body" class is narrower than the FRBR corporate body because it specifies legal recognition. FRBR$_{OO}$ introduces the class "corporate body" into the CRM model as a subclass of "group" and a superclass of "legal body." The FRBR entity is mapped to CRM in such a way that it joins into the CRM model by attaching to relevant classes through narrower than/broader than relationships but it is a new class that introduces the particular FRBR meaning within the FRBR$_{OO}$ extension to the CRM model. This is a simple example where the harmonisation was achieved by identifying how to mesh together the existing entities of each model.

There are also cases where FRBR$_{OO}$ appears quite different from the original FRBR family of entity relationship models. FRBR$_{OO}$ goes beyond FRBR$_{ER}$ because it does not limit itself to the set of data actually captured and stored by the library community. It aims to map all the entities and attributes/properties associated with the products which are collected and shared by libraries, not just those that are directly related to the products. Thus, it often breaks down entities into finer parts, pulls out implicit information, and also looks at all the processes and activities that generate the products. It is only from within this more detailed framework that one can more accurately identify the points of contact between the data and models of the different communities. The original FRBR model generated useful insights into the structure and relationships of bibliographic data. To connect with the museum community, it was necessary to parse FRBR entities more finely, to analyze relationships more specifically, etc., in order to find the common points where the meanings of one model and the other would be able to interconnect.

One example is the manifestation entity. In FRBR, a manifestation is the physical embodiment of an expression of a work. It can be a published book or a manuscript, a published poster or an original painting. Connecting the entity "manifestation" into the CIDOC CRM model was problematic because the FRBR meaning has both a conceptual and a physical aspect. If the manifestation is a single manuscript, written by the author, it is a physical object. It embodies the author's expression of the work. The published book represents a set of objects that all have the same characteristics because they were published together at the same time. Once the set is dispersed after leaving the publisher's

loading dock, we can imagine the set, but it takes on an abstract aspect. FRBR$_{OO}$ separates the entity manifestation into two: manifestation singleton – something produced as a unique object, such as the author's original manuscript; manifestation product type – the set of characteristics that belong to all copies of the book published at a particular time and place by a particular publisher. From a library perspective, this may seem an unnecessary complication. From the perspective of the museum community, the manuscript is a type of physical man-made thing; the printed book is an information carrier produced by an industrial process. This distinction may not be important when we are exclusively within the library community. For our data to interoperate with that of the museum community, this distinction is important. The manuscript, the manifestation singleton, sits in the model not far from a painting and a sculpture. The printed book, the item that has a particular manifestation product type, sits in the model close to information carriers and legal objects with rights. It is a different perspective; it is worth doing because it leads to a cleaner and more valid mapping of meaning between the two models. It also gives insights into complexities that were not evident or relevant in the original FRBR model. A medieval Book of Hours may actually have more in common with a Renaissance painting than with a mass-produced paperback, especially in a database that combines the holdings of libraries, museums and archives.

In a related example, FRBR$_{OO}$ unpacks the publication process and provides a useful insight: the very process of taking the author's expression, preparing it for publication, choosing font and layout, covers, etc., means that the process of publishing has an effect on the final product collected by the library. In FRBR$_{ER}$, the manifestation simply embodies the expression. This is sufficient for library needs in most cases. FRBR$_{OO}$ parses the entity expression into more specific subclasses. It distinguishes "publication expression", which is the set of signs as published, combining the author's expression with the publisher's decisions about font, layout, pagination, etc. It adds a layer between FRBR$_{ER}$'s expression and manifestation entities and acknowledges the contribution of the publisher to the final product. In many case, it may not be important. But for the few instances when it may be important, FRBR$_{OO}$ provides the mapping so that real-life implementations will be able to deal with this data.

One major area of difference between FRBR$_{ER}$ and FRBR$_{OO}$ is the introduction of temporal entities, events and time processes in FRBR$_{OO}$.

> FRBR$_{ER}$ envisions bibliographic entities as static, ever-existing things that come from nowhere, and overlooks the complicated path from the initial idea for a new work in a creator's mind to the physical item in a user's hands through the dramatically important decision-making on behalf of publishers, as this complicated path is not explicitly reflected in

data actually stored in bibliographic databases and library catalogues, which constituted the domain of reference of the FRBR Study Group.[17]

The FRBR family of entity-relationship models make references to time, but not as an entity or process. Time is captured in the attributes that are considered significant, such as date of work, date of manifestation, dates associated with a person, family, or corporate body. By considering "dates" as attributes, it limits the capturing of change over time, and it pays little attention to processes such as creation, performance and publication which may be affected by time.

The FRBR model has a single entity "event." This entity is fairly narrowly defined, because it is limited to actions or occurrences that may be the subject of a work. It does not address events that may be significant during the life cycle of works, expressions, manifestations, and items.

Carl Lagoze, speaking about metadata as a cross-community activity, points out:

> A particular metadata description, a record from some community in some schema, actually refers to a *snapshot* of some entity in a particular state – a perceived fixity of the entity in a particular time and place that perforce elides events or lifecycle changes that are outside the domain of interest by the particular descriptive community. The granularity of that snapshot (and the number of elided or revealed events) varies across metadata vocabularies.[18]

In trying to map metadata from different communities, an awareness of the different ways in which each community treats time can be an important key for finding the commonalities in vocabulary.

The focus of the original FRBR family of models was on the products of processes, not the processes themselves:

> FRBR models the outcomes (work, expression …) of processes (such as creation, realisation, planning) but does not deal with the processes themselves. $FRBR_{OO}$, building on the approach of CRM, focuses on processes.[19]

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[17] *FRBR: object-oriented definition and mapping from $FRBR_{ER}$, FRAD and FRSAD*. Version 2.2. 1.1.9, p. 12-13 of pdf. http://www.ifla.org/files/assets/cataloguing/frbr/frbroo_v2.2.pdf

[18] Carl Lagoze. *Business unusual: how "event-awareness" may breathe life into the catalog?* Prepared for the Bicentennial Conference on Bibliographic Control for the New Millennium, Library of Congress, November 15-17, 2000. http://www.loc.gov/catdir/bibcontrol/lagoze.html

[19] Pat Riva, Martin Doerr, Maja Žumer. $FRBR_{OO}$: enabling a common view of information from memory institutions. *International Cataloguing and Bibliographic Control* 38:2 (April/June 2009), p. 31. Also available online in an earlier version as a conference paper for the 2008 IFLA congress: http://www.nlc.gov.cn/newen/fl/iflanlc/iclc/IFLAds/201012/P020101210597174010207.pdf

The CIDOC CRM temporal entity (E2) and all its subclasses (such as Event, Activity, Creation) are a key part of the CRM model. FRBR$_{OO}$, as an extension of the CIDOC CRM, requires the incorporation of time in order to fit with CRM modelling. But incorporating time has also provided added explanatory power for the FRBR model because bibliographic data is generated, modified and connected to related data against the backdrop of time spans, events and processes. FRBR$_{OO}$ models both the outcomes and the processes or events.

Performance is a good example of the impact of FRBR$_{OO}$. In the original FRBR model, performance is an example of an expression of a work. It was an important example to explain the meaning of the entity "expression," and to clarify that performances were not to be understood as identical to the textual expression of a play. This was a good starting point, but actually brought to the fore more complexities. The performance itself is not part of the library's collection. The library actually collects the artefacts generated by the event "performance". These can be recordings of the performance, embodying different expressions of a work, or related works such as printed programs and posters. In FRBR$_{OO}$, performance is understood as an activity, a type of event and this event is related to different propositional objects, such as the performance work and the performance plan. Performance plan is the set of all instructions for that performance and, when it is not an improvisation, incorporates an expression, such as the text of a given play, or the score for a musical work.

> Performers make decisions about all the features their performance should display (whether it is an improvisation or it involves some pre-existing work such as a play or a musical composition), and may express these decisions as explicit instructions. This is modelled as: F31 Performance (i.e., the performing activity itself) R25 performed (was performed in) F25 Performance Plan (i.e., the set of instructions for a specific performance …).[20]

FRBR's notion of performance is a generalized abstraction that is challenging to use in actual implementations within the broader domain of cultural heritage data. In FRBR$_{OO}$, the notion is analyzed more finely, separating activities and objects to ensure a valid mapping of library data while also fitting with the data models of other cultural heritage communities.

Another significant way in which FRBR$_{OO}$, version 2.2, differs from the three original ER models is that it expresses all three models together in one object-oriented model. FRBR$_{OO}$ ventures into consolidation on the object oriented side, while the consolidation project undertakes consolidation of the three entity-relationship models. FRBR$_{OO}$ transforms the abstractions of the FRBR$_{ER}$ models into something quite different because it provides a very detailed analysis of entities and relationships, it captures a broad range of details to enable a smoother transition from model to implementation, and it was deliberately designed to fit

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[20] *FRBR: object-oriented definition and mapping from FRBR$_{ER}$, FRAD and FRSAD*. Version 2.2. 1.1.9, p. 22-23 of pdf. http://www.ifla.org/files/assets/cataloguing/frbr/frbroo_v2.2.pdf

with the CIDOC CRM model. While it cannot offer any easy solutions for the consolidation project, it has provided insights that are informing decisions during the consolidation process, such as bringing the notion of "time" into the consolidated conceptual model.

The consolidation of the FRBR family of models

The goal of consolidation is to produce a single entity-relationship library reference model that integrates the three original models, FRBR, FRAD and FRSAD.

As far back as 2009, just as FRAD and FRSAD were just being officially approved and published, the FRBR Review Group already recognized that the three models needed to be harmonized. As noted in the minutes of the 2009 Review Group meetings:

> The ultimate goal is a single conceptual model statement. Even though FRAD and FRSAD were originally charged as extensions of FRBR, their results have taken fresh looks at various aspects. Integrating these three reports will certainly raise some basic issues.[21]

The Review Group recognized that each of the models brought important insights but had different perspectives, different levels of granularity, and, in some place, slightly different interpretations. Rather than try to take one pre-existing model and add to it, the consolidation started by levelling the playing field and analyzing the constituent parts of each model. All three models have the same major components: user tasks, entities, attributes and relationships. Thus, the first step was to work through the lists of user tasks, entities, attributes and relationships from each of the models, analyze how they differed or confirm that they were similar in meaning. This exercise required an analysis of the meaning, not just the name. Since each of the models was developed to focus on a particular subset of bibliographic data, even where names were identical, definitions differed. For example, the straightforward user task "find" is defined slightly differently in each of the three models:

> **Find**
> FRBR: to <u>find</u> entities that correspond to the user's stated search criteria (i.e., to locate either a single entity or a set of entities in a file or database as the result of a search using an attribute or relationship of the entity)
>
> FRAD: Find an entity or set of entities corresponding to stated criteria (i.e., to find either a single entity or a set of entities using an attribute or combination of attributes or a relationship of the entity as the search criteria); or to explore the universe of bibliographic entities using those attributes and relationships.

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[21] FRBR Review Group. *Meeting Report Milan, Italy, August 25 and 26, 2009,* section 3. IFLA FRBR Review Group website: http://www.ifla.org/files/assets/cataloguing/frbrrg/meeting_2009.pdf

FRSAD: **Find** one or more subjects and/or their appellations, that correspond(s) to the user's stated criteria, using attributes and relationships;

While there is no significant clash in meaning, no single definition can be used "as is" in the consolidated model. The Consolidation Editorial Group will develop a definition that brings together the three meanings and is appropriate for the consolidated model.

There are other cases where the meaning of an entity with the same name is quite different from one model to the other. For example, the entity "person" has conflicting definitions in FRBR and FRAD:

Person

FRBR: An individual.
Encompasses individuals that are deceased as well as those that are living.

FRAD: An individual or a persona or identity established or adopted by an individual or group.
Includes real individuals; personas or identities established or adopted by an individual through the use of more than one name; personas or identities established or adopted jointly by two or more individuals; literary figures, legendary figures, divinities, and named animals as literary figures, actors, and performers; personas or identities established or adopted by a group, etc.

At issue is the conflict between the definition of person as a real person versus the definition that includes both real and fictitious persons. The question of identities, personas, pseudonyms is not a problem because it can be handled easily through the relationship between a person and a name. But the question of whether person is a real person or can include fictitious persons is a substantive question that must be resolved in order to present a coherent model.

The original task of "harmonizing" the models has led to a detailed examination of every component and to a new modelling exercise to see how all the parts can fit together into one model. The word "consolidation" is now seen as a more accurate description of the work. The consolidation exercise has required a re-modelling to identify and eliminate inconsistencies and disparities between the three models.

In the words of Pat Riva, past chair of the FRBR Review Group and current chair of the Consolidation Editorial Group:

The goal of producing a consolidated model is to remove barriers to the adoption of the IFLA FR family of conceptual models by spelling out how the three models fit together as well as

incorporating insights gained since their initial publications, and providing the entire model definition in a single document.[22]

The consolidated model will be a high-level entity-relationship model, with fewer entities than the original three models, and with fairly general relationships and attributes, focusing on significant and representative ones rather than on detailed listings. A number of the original attributes will also now be modelled as relationships. The consolidated model is taking shape, but it is still in in the process of being developed and has not yet been formally reviewed or approved.[23]

The consolidated model is different from $FRBR_{OO}$ and fulfills a different function. They both use the three original models as their starting point, but the subsequent developments are not the same and are intended for different purposes. $FRBR_{OO}$ presents a unified interpretation of the three models, but it is an interpretation, it uses an object-oriented methodology and it is intended to fit with the museum community's conceptual model, CIDOC CRM. $FRBR_{OO}$ is the result of dialogue with the museum community to arrive at common ground in order to support data interoperability between library and museum data. It is intended to be a formal ontology to support practical applications. The consolidated model is intentionally more general and abstract than $FRBR_{OO}$; it is not an interpretation of the three original models, but a remodelling of the three into one coherent conceptual model where there is internal consistency in all areas. It too is designed to make it easier to apply the conceptual modelling of FRBR, FRAD and FRSAD but at a more theoretical level.

In the analysis to bring the three models together, attention was paid not only to internal consistency of meaning, but also to tight and consistent modelling. Consolidation is taking place in an environment informed by the modelling experience of $FRBR_{OO}$. One example of this influence is the proposal to introduce a temporal entity into the consolidated model. The original FRBR family of entity-relationship models make references to time, but in a limited way. The entity "event" was considered only as a subject of a work, a part of the FRBR group 3 entities. With such a narrowly defined focus, it does not play a significant role in the modelling. Time is modelled as an attribute of certain entities, such as date of work, date of manifestation, dates associated with a person, family, or corporate body. In order to make reference to time data in the models, it has to be listed as an attribute. One of the criticisms of the original $FRBR_{ER}$ model was the choice of attributes, both the long lists and the omissions.[24] There is a loss of flexibility when data is modelled as an attribute. When

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[22] Pat Riva. Draft document of the FRBR Review Group. 2014.

[23] Any reference in this article to the content of the consolidated model should be understood to be subject to change, depending on feedback during the review process.

[24] Maja Žumer. *Some Outcomes of the CRM/FRBR Harmonization: the Definition of Manifestation and a Review of Attributes.* Presentation at the FRBR workshop: FRBR in 21st Century Catalogues, an invitational workshop, Dublin, Ohio, May 2-4, 2005. Http://www.oclc.org/research/activities/frbr/frbr-workshop/program.html

one considers how many times "date" is repeated as an attribute, it gives rise to the idea that perhaps time could be more efficiently modelled as an entity in its own right, and the specific types of dates can be modelled as relationships between the time entity and other entities. The consolidated model proposes "time-span" as an entity, thus bringing time into the model. This proposal would also streamline and tighten the modelling, providing greater flexibility by eliminating the need to pre-define all time relationships. By introducing time-span as an entity, the model would no longer require endless attributes related to time. It would still model this data, but model it as relationships and types of relationships rather than as attributes. This would also bring the consolidated model more in line with the data modelling of the linked data environment, where relationships are increasingly emphasized.

The evolving FRBR family of models

As the information environment develops, emphases adjust and expand. There is still a fundamental commitment to ensure reliable discovery of relevant resources. Increasing importance is being given to data retrieval across the boundaries of different cultural communities, as well as to refining the structure of data to provide a better fit with the linked data environment.

Both $FRBR_{OO}$ and the consolidated model take the three original IFLA conceptual models as their starting point and develop new modelling that builds on the original. But they each have different purposes and the resulting models are each unique.

$FRBR_{OO}$ 2.2 is an interpretation of the three models, using an object-oriented methodology. Its purpose is to be a valid extension of the museum community's conceptual model, CIDOC CRM, and to add modelling for bibliographic data that broader cultural heritage community can use. As stated in the $FRBR_{OO}$ introduction: "[it is] a formal ontology that captures and represents the underlying semantics of bibliographic information and therefore facilitates the integration, mediation, and interchange of bibliographic and museum information."[25] Since it is written as a formal ontology, it makes FRBR concepts more accessible for real-world, current applications, such as the work on the EDM – $FRBR_{OO}$ Application Profile.

It is not easy to apply three separate models for bibliographic data, no matter how inter-related. Each model contributed to an internationally shared understanding of bibliographic data, but the models were not completely consistent with each other and were also developed with different levels of granularity. The conceptual framework expressed in three models was recognized as important but it was challenging to apply. Where there are differences between the models, the international community needs to be in agreement about how the models fit together so that we can use the concepts effectively, continue to

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[25] *FRBR: object-oriented definition and mapping from FRBR$_{ER}$, FRAD and FRSAD.* Version 2.2. 1.1.9, p. 10 of pdf. http://www.ifla.org/files/assets/cataloguing/frbr/frbroo_v2.2.pdf

benefit from a shared understanding and modelling of our data, and provide a robust model for resource discovery. The consolidation remodels the three original models into one coherent one where there is internal consistency in all areas as well as efficient and robust modelling.

Bibliographic data is sought and used in increasingly complex environments. Both FRBR$_{OO}$ and the consolidated model will ensure that the valuable work accomplished by IFLA in creating the original models remains relevant and applicable in these new environments. These two areas of development will keep the conceptual framework expressed in the original FRBR family of models in step with the demands of the current information-seeking environment and relevant as a key source for modelling bibliographic data.