From a Conceptual Model to Application and System Development

by Athena Salaba and Yin Zhang

Functional Requirements for Bibliographic Records

Many library catalogs and other information retrieval systems today do not support all the functions of the catalog as stated over a century ago by Cutter [1] and, within the last decade, by Lubetzky [2]. Past studies cite the failure to collocate all versions of the same work and the decision to ignore bibliographic relationships between different works and among expressions and manifestations of the same work as the reason for this lack of functionality [3].

In an effort to ease users' difficulties in searching catalogs, library communities have begun to incorporate the ideas within IFLA's *Final Report on Functional Requirements for Bibliographic Records* (FRBR) [4]. The foundation of FRBR is the distinction of four bibliographic entities (Group 1): *work, expression, manifestation* and *item* (IFLA, 1998).

FRBR is a conceptual, entity-relationship model; it is open to various interpretations and implementations. Thus, those currently implementing all or part of the FRBR model have taken different approaches with respect to aspects such as user interface and display, system features, FRBR model focus, collection and other technical system implementation details. A survey of current system development, implementation efforts and different applications of the FRBR model is needed in order to gain a better understanding of these activities, solve application issues and plan for more successful FRBR projects in the future. This paper provides a brief overview of the types of collections and settings to which FRBR has been applied and existing literature that has previously examined FRBR application to some of these types of collections and settings. In addition, a brief overview of current system development efforts and supporting tools for creating FRBR-based systems and data is provided.

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Yin Zhang and Athena Salaba are the recipients of an IMLS Leadership grant titled "Research and Development of FRBR-Based Systems to Effectively Support User Tasks and Facilitate Information Seeking."

FRBR Application

FRBR can be applied to all kinds of settings and collections, both format-based and domain-specific. Noerr, Goossens, Matei, Otten, Peruginelli and Witt [5] list a number of benefits for both the end user of a library catalog and the library staff, including easier searching, focused results, clustering at the work level, understanding and using bibliographic references and better navigation for end users. Among the benefits for library staff, the authors list better placement of data in records, easier copy cataloging and sharing of records and adding new data such as rights management.

The application of the FRBR model is expected to be more beneficial to certain types of resources than others. In general, collections thought to benefit the most are those consisting of works expressed in a variety of ways, such as those published in different editions by different publishers and in different mediums. This category includes fictional works, music collections, serial collections and other aggregate works. In other words, the model will be most advantageous for users who are looking for works with many expressions and manifestations, but not as helpful for works with one expression and very few manifestations.

The following is a brief overview of applications relating to types of collections and different settings (information environments). For each listing, a brief description of one or two identified issues is presented.

Collections (Format and Disciplinary Communities). Examples of collections covered in the literature regarding FRBR application include collections of works of art, literature, classical texts, fiction, serials and other continuing resources, electronic resources, music, film >

and the performing arts. The information that follows is based either on current literature, discussion related to these types of collections or from the listed FRBRization projects themselves.

- **Artworks.** Traditionally, works of art are described using an object-oriented model. These works are single-object entities related to many other objects. An expansion of FRBR relationships might be necessary if the model is to be applied to the description and access of works of art [6].
- **Classical texts.** Latin and classical Greek texts have also been the subject of FRBRization discussions. Like art, collections of classical texts include many works related to other works. The Perseus Digital Library has done an extensive study on how to apply the FRBR model to classical texts to create a hierarchical catalog [7].
- **Fiction.** Fictional works are thought to be the materials that will benefit most from the application of the FRBR model. These collections include works with a number of expressions, often with several manifestations under each expression and relationships to other works such as adaptations. One of the earliest and largest FRBR applications to fictional works is OCLC's creation of FictionFinder (see description in Table 1).
- **Film and video.** It is necessary to distinguish between film and video expressions and film- and video-related adaptations within this category of materials. One issue arises in accessing the same film stored in different containers, for which current cataloging rules require the creation and display of individual bibliographic records. At the UCLA Film and Television Archive (see description in Table 1), this issue has been resolved by including manifestation information in the holdings record instead of in the bibliographic record [3].
- **Hand-press materials.** Concerning the application of the FRBR model to hand-press materials, Jonsson [8] points out an issue with the specificity of the definition of the expression entity. Variations during the production process of hand-press materials can result in a number of slightly differing versions among copies of the same edition, resulting in a needless and confusing excess of expressions if one abides by the current definition. As a solution, Jonsson proposes leaving the definition of expression to a general level of identification rather than a specific one.
- **Literature.** National literature with an author-centered focus has also been the subject of FRBR application. The best example in this area is AustLit's effort (see description in Table 2) to provide access to all works by and literary criticism of Australian authors as well as the compilation of all pertinent information about the career, work and life of each artist.
- **Live performing arts.** Live performances are a unique type of collection in that libraries do not hold copies of the same performance of a work and usually must link to materials related through other types of bibliographic relationships. Related materials may include photographs, programs, costumes, clippings, manuscripts and choreographic notations [9].
- **Music.** Music collections are another area that can greatly benefit from the application of FRBR. Due to the nature of these materials, it is not easy to define the boundaries of relevant works and expressions. Different types of musical works include individual works, aggregated musical works, fragments of musical works and works of vocal music [10]. In addition, an extensive list of bibliographic relationships exists among entities within music collections.
- **Oral tradition works.** Nicolas [11] states that the application of FRBR allows a better treatment of works within oral traditions. One issue involved with these collections is the compatibility of FRBR's expression to the different versions of these works.
- **Serials and other continuing resources.** One area that has received much attention in attempts to apply the FRBR model is serials and other types of continuing resources. Among the discussions for applying FRBR to serials are the issues of seriality, serials as aggregated works, format variation (multiple versions of the same journal) and the issue of frequent journal title changes. A higher level of abstraction has been proposed for serials [12].

Settings. FRBR was developed by the library community to better serve user tasks. However, this does not mean that FRBR is applicable only within traditional libraries. Other and more specialized settings for the potential application of FRBR have been discussed among the international community. The following are examples of such settings:

- **Traditional libraries.** FRBR was developed within the library community to help identify the functional requirements for library bibliographic records. >

Therefore, the main audience of the report and the most likely setting in which to apply the model is the traditional library environment.

- **Consortia.** Libraries often participate in networks or consortia for records and resource sharing. One issue that arises is whether FRBR will make record-sharing easier or more difficult. Examples of issues to be resolved include what information should be part of the bibliographic record and what information part of the authority record. At what level should we create records: work-level, expression-level, manifestation-level or all?
- **Digital libraries.** Those conducting a number of digital library projects are interested in applying the FRBR model to their data to create hierarchical catalogs. One distinguishing characteristic of many digital libraries is that they do not use the same standards for description or encoding as traditional libraries use such as MARC and AACR2. Digital libraries provide access to a variety of dynamic materials and typically need more detailed descriptions and additional types of information such as preservation, rights management, structural and use information.
- **Institutional repositories.** Many universities and other institutions are charged with the management, preservation, dissemination and provision of access to institutional and scholarly assets via a single repository. Several challenges are involved with institutional repositories due to their variety of assets and the different functional requirements for each type of asset to be included. These repositories could greatly improve their accessibility and quality with the application of FRBR.
- **Internet archives.** One major challenge with the Internet is the fluidity of web resource content and multiple versions of each resource. There is great potential to solve many of these issues by exploring how best to apply the FRBR model to this setting.
- **Museums.** This environment differs from the traditional library setting in that it collects unique works of art and often uses an object-oriented model for resource representation. Due to the similar aspects of libraries and museums, there is a great effort toward harmonizing the entity-relationship FRBR model with the object-oriented conceptual reference model (CRM) of the International Council of Museums (http://cidoc.ics.forth.gr/).
- **Portals.** These discovery tools can provide federated searching functionality using a single metasearch interface across multiple information resources such as journal databases, reference sources and remote services in addition to enabling access to library catalogs. Portals often offer full-text retrieval or delivery through a variety of technologies such as email, chat rooms and instant messaging.

FRBR System Development

The FRBR model offers great opportunities for creating retrieval systems that better support user information seeking since it was developed with user tasks in mind. Current FRBR implementation efforts have been largely exploratory in nature and focused in the following categories:

- Library online catalogs
- Digital libraries
- Systems and supporting tools, algorithms and utilities

Among the FRBR-based systems developed, some are full-scale working systems such as OCLC's Worldcat.org (www.worldcat.org/). Others are prototypes or experimental test systems that explore FRBR implementation, such as Libraries Australia (http://ll01.nla.gov.au/). A number of these FRBR-based systems are based on the FRBRization of existing data or an existing information storage and retrieval system. FRBRization refers to the process of converting existing data or systems to conform to FRBR requirements. The majority of the current FRBR systems and prototypes are considered FRBRized systems; very few are new systems independent of older practices. A number of issues are involved in any FRBRization project, many of which have been identified by Yee [3]. A main issue is that most FRBRization projects have used only bibliographic data for the identification of works, whereas authority data are also valuable sources for work representation and identification. In addition, subject data are associated with bibliographic records only, although it would be beneficial also to include them in work authority records. A variety of bibliographic data can serve to identify variations among multiple expressions of the same work. These data are designed to be interpreted by humans, so it is not always easy for machines to automatically process them. In this way, automatic FRBRization projects fail to exploit these data.

An overview of current FRBR-related implementation efforts in over 20 FRBR development projects follows. The variety of FRBR projects showcases how FRBR may be applied and implemented for different purposes. >

TABLE 1. FRBR-Based Library Catalog Systems

TABLE 1A. Full-Scale Working Systems

WorldCat.org
Online Computer Library Center (OCLC)
www.worldcat.org/
The WorldCat database is the largest and most comprehensive union catalog, utilizing a FRBR-like approach via the OCLC Work-Set Algorithm. The records represent items from languages and cultures in libraries in 112 countries and territories from around the world.

UCLA Library – Film and Television Archive
University of California at Los Angeles
http://cinema.library.ucla.edu/
The UCLA Film and Television Archive is the second-largest media materials collection in the United States. Launched in early 2007, the OPAC for this institution embodies many of the principles of FRBR and cataloging.

TABLE 1B. Prototypes

OCLC FictionFinder
Online Computer Library Center
http://fictionfinder.oclc.org/
FictionFinder is a FRBR prototype of OCLC research that provides access to over 2.9 million bibliographic records for books, e-books and audio materials that fall under OCLC's fiction category.

Libraries Australia
National Library of Australia, National Australian Bibliographic Database
http://ll01.nla.gov.au/
This FRBR-like prototype system, a copy of the Australian National Bibliographic Database as of January 2006, was developed as a demonstration of searching MARC bibliographic records using Lucene.

RedLightGreen
Research Libraries Group (formerly funded in part by the Andrew W. Mellon Foundation, now part of OCLC)
Project information available at
www.rlg.org/en/page.php?Page_ID=433
RedLightGreen was an online union catalog designed specifically as an intuitive online research tool for undergraduate students. RedLightGreen's role has largely been taken over by WorldCat.org.

BIBSYS
Norwegian National Library, Norwegian University of Science and Technology, Library of Norway
www.bibsys.no
Prototype available at
http://november.idi.ntnu.no/frbrized/
BIBSYS supplies library and information systems to over 100 Norwegian libraries and institutions of higher learning, including university libraries, research institutions and the Norwegian National Library. Records of the BIBSYS bibliographic database have been successfully FRBRized through the development of an XML-based tool that extracts relevant entity information from MARC records.

TABLE 1C. Vendor-Developed Catalog Systems and Initiatives

Virtua ILS (Integrated Library Systems)
VTLS (Visionary Technology in Library Solutions)
Product information available at
www.vtls.com/brochures/virtua.pdf
In Virtua, VTLS has attempted to create an environment in which records following the FRBR model can co-exist with records in traditional cataloging models. The software is "FRBR aware" and automatically switches display formats depending on the type of record accessed.

Innovative Interfaces
Innovative Interfaces, Inc. (III)
Product information available at www.iii.com
Innovative Interfaces has investigated the potential integration of FRBR into their line of products – specifically, the Millennium staff system and web OPAC – to enable users to return structured search results of works available in many different versions, formats and languages. Further development and product release is on hold pending the release of FRBR implementation within RDA.

VisualCat
Portia
Product information available at
www.portia.dk/pubs/AccessY2K/VisualCatRdf/VisualCatRdf_files/frame.htm
VisualCat is a cataloging software system developed and distributed by Portia as an integrated solution for copy cataloging and bibliographic metadata management, using both FRBR and XML to implement a more accurate and user-friendly catalog.

Library Catalogs. Developing FRBR-based catalogs has been actively explored in many ways and, at this early stage of FRBR development, varies to a great extent because of a lack of developed standards, guidelines and adequate examples. Most current FRBR-based catalogs are prototypes that explore possible means for implementing the FRBR model with certain types of collections and for a specific setting, but very few are full-scale working systems that have actually been put into service. The FRBRization of existing catalog systems and records has been the major focus due to the practical concern that it is unrealistic to recatalog existing collections. Not surprisingly, systems, utilities, tools and software have been developed to facilitate the FRBRization process. Also, notably, vendors and software manufacturers and distributors have been actively investigating possible ways to integrate FRBR into their product lines. A list of current FRBR-based catalogs is shown in Table 1. >

Digital Libraries. Many digital libraries have been created in nontraditional library settings such as special collections, museums, digital collections, archives and Internet resources. Additionally, FRBR has been applied to create systems for digital rights management. Some characteristics of many digital library collections are the variety of resource types and the information needs of the different audiences they serve. Therefore, most of these projects deal with different standards for description and require different types of elements to provide effective access to their collections. A number of digital libraries have used existing metadata records and added FRBR-like features to their end-user interface either as search or display features. To accommodate this variation, a number of digital libraries have modified the FRBR model during the process of application and system development. Some examples of digital libraries with FRBR or FRBR-like features are shown in Table 2.

Systems and Supporting Tools, Algorithms and Utilities. FRBR system development efforts have focused on developing either FRBR systems and prototypes or supporting tools, algorithms and utilities. These tools are specifically designed to convert existing data to FRBRized data or to create FRBRized displays of existing traditional data. For example, OCLC has developed algorithms that convert sets of MARC bibliographic records to conform to FRBR requirements. The Library of Congress has developed the FRBR Display Tool, which allows libraries to display their resources by clustering bibliographic records according to the FRBR model. Such tools, algorithms and utilities also play an important role in FRBRizing existing data and systems. In addition, some commercial products are becoming available to provide FRBR-like displays of results from an existing non-FRBR system. Examples of supporting tools, algorithms and utilities are shown in Table 3. >

TABLE 2. Examples of Digital Libraries with FRBR or FRBR-like Features

AustLit: The Resource for Australian Literature
National Library of Australia, et al.
www.austlit.edu.au/ (accessible by subscription only)
AustLit is a web-based discovery service consisting of more than 460,000 records devoted to Australian authors and literary criticism.

Music Australia
National Library of Australia, et al.
www.musicaustralia.org
MusicAustralia is a web-based discovery service geared toward Australian music in all formats, styles and genres.

Paradigma
National Library of Norway
(URL is not currently available. Previously reported URL is www.nb.no/paradigma/eng_index.html)
Paradigma was a three-year project scheduled to end in December 2004. It was designed to archive online "dynamic" documents and, therefore, much of today's digital culture in Norway for long-term preservation in the Digital Archive of the National Library of Norway.

Perseus Digital Library (PDL)
Tufts University
www.perseus.tufts.edu/hopper/
The Perseus Digital Library consists of a collection of 1,000-2,000 distinct classical Greek and Latin works with rich fundamental relationships to other works.

NCSU E-Matrix
North Carolina State University Libraries
www.lib.ncsu.edu/e-matrix/
E-Matrix is an Oracle-based serials, journals and electronic resources system in development.

National Film and Sound Archive (formerly ScreenSound Australia)
Australian Film Commission
www.nfsa.afc.gov.au/screensound/screenso.nsf
The National Film and Sound Archive is the national audiovisual archive of Australia. Its purpose is to collect, store, preserve and make available screen and sound items relevant to Australian culture. This large collection is organized through MAVIS.

River Campus Libraries–Video, River Campus Libraries–Music Projects
University of Rochester, River Campus Libraries
www.lib.rochester.edu/index.cfm?page=videos;
www.lib.rochester.edu/index.cfm?Page=cds
These two RCL catalogs were developed to simplify users' searches for audio and audiovisual resources in the 7500-item video/DVD collection and the 1000-item CD collection.

ECHO (European CHronicles On-Line)
Instituto Luce, Institut Nationale Audiovisuel, Netherlands Audiovisual Archive, Memoriav, et al.
Project information available at http://pc-erato2.iei.pi.cnr.it/echo/
Funded by the European Community, the ECHO project aimed to develop a long-term, reusable software infrastructure and new metadata models for films to support the development of web-based, interoperable audiovisual digital libraries.

Variations2
Indiana University, School of Music
Project not available online, but further information available at http://variations2.indiana.edu/research/
The Variations2 project aims to establish a digital music library test bed system containing music in a variety of formats.

Conclusion

For years now, since the publication of the Final Report on the Functional Requirements for Bibliographic Records (FRBR), information specialists have applied and/or implemented this conceptual model to settings such as libraries, digital libraries, museums, archives and the Internet. A number of catalogs and other information retrieval systems have been developed either as fully functional systems or as prototypes and experimental projects to explore various means of FRBR implementation. In addition, tools and supporting software have become available to assist in FRBRizing existing systems and data. All these efforts can serve as a basis for the development of standards, implementations and other projects that aim to apply the user-centered FRBR model to provide more effective access to information.

There have been many challenges and issues in FRBR application and implementation. In addition to those covered in this article, the article in this special issue by Zhang and Salaba reports the top-rated critical issues facing FRBR research and practice from a Delphi Study involving a panel of FRBR experts. Several of the most critical issues are related to FRBR application and implementation. In addition, another article in this special issue by Maja Žumer specifically discusses issues and possible solutions in FRBR implementation. >

TABLE 3. Examples of Supporting Tools, Algorithms and Utilities

Conversion Tools

OCLC FRBR Work-Set Algorithm
Online Computer Library Center
www.oclc.org/research/software/frbr/default.htm
www.oclc.org/research/projects/frbr/algorithm.htm
The OCLC FRBR Work-Set Algorithm was developed to examine the issues associated with the FRBRization process.

Tool for Converting Bibliographic Records
Norwegian National Library, Norwegian University of Science and Technology, Library of Norway
www.ercim.org/publication/Ercim_News/enw66/aalberg.html
The tool, developed for the BIBSYS project, is based on XML and creates automatic XSL transformations converting existing MARC records.

Display Tools

FRBR Display Tool
Network Development and MARC Standards Office, Library of Congress
www.loc.gov/marc/marc-functional-analysis/tool.html
Currently at Version 2.0, the FRBR Display Tool is a freely-downloadable tool for the analysis of MARC data through the work, expression, manifestation and item entities of the FRBR model.

FRBR Floater
Monte Sano Associates
www.montesanoassociates.com/apps-msafrbr.htm
FRBR Floater is a subscription service that enables users to view, via a pop-up OPAC window, various editions and formats of items owned by a particular library of any title searched.

Systems

IFPA (ISIS FRBR Prototype Application)
Roberto Sturman, University of Trieste
http://pclib3.ts.infn.it/frbr/wwwisis/FRB2.01/FORM.HTM
The IFPA tool relies on the CDS/ISIS software environment and is an experimental FRBR tool that can be viewed freely on the web. It was developed to manage the data and relationships implied in the FRBR model and serves as an application for the UNESCO ISIS retrieval software.

LibDB
Morbus
http://sourceforge.net/projects/libdb
LibDB is a library and asset management system inspired by FRBR, RDF triples and end-usability. It supports cataloging of all types of resources such as movies, books, comics and serials.

MAVIS (Merged AudioVisual Information System)
Wizard Information Services, National Film and Sound Archive (Australia)
www.wizardis.com.au/products/mavis/mavis.htm
MAVIS is a comprehensive media asset management software application that accommodates the needs of collections ranging from limited specialist to national libraries.

Resources Mentioned in the Article

[1] Cutter, C. A. (1904). *Rules for a dictionary catalog.* (4th ed.). (Rewritten.) Washington: Government Printing Office.

[2] Lubetzky, S. (2001). The function of the main entry in the alphabetical catalogue – One approach. In *Seymour Lubetzky: Writings on the classical art of cataloging.* Comp. and ed. Elaine Svenonius, Dorothy McGarry. Englewood, CO: Libraries Unlimited, pp. 231-237.

[3] Yee, M. M. (2005). FRBRization: A method for turning online public finding lists into online public catalogs. *Information Technology and Libraries, 24*(3), 77-95.

[4] IFLA Study Group on the Functional Requirements for Bibliographic Records. (1998). *Functional requirements for bibliographic records: Final report.* UBCIM Publications – New Series. Vol. 19, München: K. G. Saur. Also available at www.ifla.org/VII/s13/frbr/frbr.htm.

[5] Noerr, P., Goossens, P., Matei, D., Otten, P., Peruginelli, S., & Witt, M. (1998). User benefits from a new bibliographic model: Follow-up of the IFLA Functional Requirements study. *International Cataloguing and Bibliographic Control: Quarterly Bulletin of the IFLA UBCIM Programme, 28*(3), 80-81. Also available at www.ifla.org/IV/ifla64/084-126e.htm.

[6] Chen, Y. N., & Chen, S. J. (2004). A metadata practice of the IFLA FRBR model: A case study for the National Palace Museum in Taipei. *Journal of Documentation, 60*(2), 128-143.

[7] Mimno, D., Crane, G., & Jones, A. (2005). Hierarchical catalog records: Implementing a FRBR catalog. *D-Lib Magazine, 11*(10), 1. Available at www.dlib.org/dlib/october05/crane/10crane.html.

[8] Jonsson, G. (2005). Cataloguing of hand press materials and the concept of expression in FRBR. *Cataloging & Classification Quarterly, 39*(3/4), 77-86.

[9] Miller, D., & Le Boeuf, P. (2005). "Such stuff as dreams are made on": How does FRBR fit performing arts? *Cataloging & Classification Quarterly, 39*(3/4), 151-78.

[10] Le Boeuf, P. (2005). Musical works in the FRBR model or "Quasi la Stessa Cosa": Variations on a theme by Umberto Eco. *Cataloging & Classification Quarterly, 39*(3/4), 103-24.

[11] Nicolas, Y. (2005). Folklore requirements for bibliographic records: Oral traditions and FRBR. *Cataloging & Classification Quarterly, 39*(3/4), 179-95.

[12] Antelman, K. (2004). Identifying the serial work as a bibliographic entity. *Library Resources & Technical Services, 48*(4), 238-255.