Functional Analysis
of the MARC 21 Bibliographic and Holdings Formats

Prepared for the
Network Development and MARC Standards Office
Library of Congress
by Tom Delsey

January 4, 2002

First Revision: March 21, 2002
Second Revision: July 14, 2003

Contents

Foreword

This study was commissioned by the Network Development and MARC standards Office in order to link MARC 21 format data with models identified in major studies that have recently been developed in the area of bibliographic control. Applying the new models from the *Functional Requirements for Bibliographic Records* (FRBR) and the related *The Logical Structure of the Anglo-American Cataloguing Rules* to the data elements accommodated in MARC 21 records was a logical step to assist bibliographic data research.   The expert largely responsible for both of the above studies carried out the analysis on contract to the Office, Tom Delsey, of Thomas J. Delsey consultancy.   By sponsoring the analysis and making it available, the MARC office and others can use the information when analyzing or making decisions on MARC 21 data related to format maintenance, system implementation, and data sharing. It will be an important tool for continuing development of MARC 21.

Mr. Delsey also carried out studies of several special topics based on this analysis, which will be made available separately.

The MARC 21 format data element set has grown in response to user requests to satisfy existing needs, the description requirements of new media, new functions identified for bibliographic data in automated systems, and changing description practices. While all additions and changes have been widely reviewed and discussed to assure that they met the principles for the format content, the emergence of an internationally accepted bibliographic data model provided an excellent opportunity to undertake a general review. The decision was made to examine MARC 21 from several perspectives: the FRBR model, a cataloguing code model, and a set of user tasks that the format might logically support. This study used the *Anglo American Cataloguing Rules* (AACR) for the cataloguing code perspective since there was already a study relating the AACR to the FRBR model. Since the AACR rules use the *International Standard Bibliographic Description* (ISBD) guidelines for a key part of the description, the rules analysis may be useful to MARC 21 users who follow other ISBD-based cataloguing codes.

The analysis was carried out using the *MARC 21 Format for Bibliographic Data* and *the MARC 21 Format for Holdings Data*, including their year 2000 updates. It has not been decided whether the analysis in the appendices will be changed with each annual format update. If the decision is made to update the analysis, a suitable scheme for marking versions will be employed and this preface revised. It is already clear that the current analysis will be very useful even without updating.

Sally H. McCallum
Chief, Network Development and MARC Standards Office
Library of Congress

January 4, 2002

Functional Analysis
of the MARC 21 Bibliographic and Holdings Formats

1. Background

The scope and complexity of the MARC formats have increased substantially over the course of its thirty-year history. What originated as a single format for communicating bibliographic data pertaining to printed texts has evolved into a suite of formats tailored to accommodate descriptions for a wide range of media, from sound recordings and audiovisual materials through to geo-spatial data files and networked electronic resources. Its original focus on library cataloguing has been extended to encompass a broad range of applications, from the management of archival holdings to the description of community information resources. Originally conceived to serve as a vehicle for communicating bibliographic data on magnetic tape from one stand-alone system to another, it now functions within a fully networked environment linking libraries with a wide range of other information providers.

In the past decade, the rapid evolution of digital information media and communications networks has posed significant challenges for the continued development and viability of the MARC format. Adapting the format to the demands of this new environment entails more than simple incremental enhancement to format specifications; it requires extensive re-examination of the underlying logical structure of the format and its application.

Over the past few years, the new technologies for recording and disseminating information, and the impact of those technologies on traditional information management practices have prompted those within the information sector to re-assess their approach to document description, resource discovery, information processing, and communication. Within the library community there have been major studies undertaken by the International Federation of Library Associations and Institutions (IFLA) and the Joint Steering Committee for Revision of the Anglo-American Cataloguing Rules (JSC), which have contributed to a clearer understanding of the nature and uses of bibliographic records and the conventions used to create those records. The models produced in those studies, as well as models developed for the publishing, sound recording and film industries, archives, and museums have the potential to significantly influence the future development of information management standards and practices both within the library community and more broadly across the information sector.

The development of the MARC formats has always been closely tied to the development of descriptive standards within the library community, and increasingly is linked to a wider repertoire of standards being developed across the broader information sector. As those standards evolve to adapt to a changing environment, it is essential for MARC format development not just to keep pace, but also to anticipate as far as possible future directions.

2. Objective

The functional analysis of the MARC format undertaken in this study has four primary objectives:
- to clarify the relationships between the data structures embodied in the MARC formats and the FRBR and AACR models
- to develop a model (based on FRBR) that reflects the full extent of data contained in the MARC formats
- to relate individual data elements within the MARC record to the uses they are designed to support
- to assist in an understanding of key issues for the future development of the MARC formats

3. Scope

The analysis covers all data elements specified in the leader, control fields and variable fields of the MARC 21 formats for bibliographic data and holdings data.

All references to MARC data elements are based on the 1999 edition of the *MARC 21 Format for Bibliographic Data* and the 2000 edition of the *MARC 21 Format for Holdings Data*, both incorporating updates to October 2000. Please note that the Appendices D (Extension of the FRBR Model) and E (Mapping MARC Data Elements to User Tasks) data incorporates updates to October 2002.

4. Approach

The study is divided into four segments.

The first segment correlates the content specified in the MARC 21 bibliographic and holdings formats with the models that have been developed for IFLA in the *Functional Requirements for Bibliographic Records* (FRBR) and for the Joint Steering Committee in *The Logical Structure of the Anglo-American Cataloguing Rules* (AACR). Each data element specified in the bibliographic and holdings formats is mapped to the corresponding entity and associated logical attribute or relationship as defined in the FRBR and AACR models. The mapping to FRBR and AACR is intended to serve as a means of relating the design of the format, at a logical or conceptual level, to the design of descriptive standards that govern the key data content of the MARC record.

The second segment of the study identifies data elements specified in the MARC bibliographic and holdings formats that fall outside the scope of the model defined for FRBR, and extends that model to incorporate definitions for entities and associated logical attributes and relationships corresponding to that additional MARC data content. The extended model serves as a means of clarifying the extent of the information contained in MARC records and the interrelationships between and among elements of that information.

The third segment of the study provides a functional analysis of the data content of the MARC bibliographic and holdings formats, building on the correspondence of logical attributes and relationships to user tasks that was developed for the FRBR study. The matrices developed for the FRBR study have been extended to reflect the additional entities, logical attributes, and relationships identified in the extended model as well as additional user tasks associated with resource use and data management.

5. Mapping of MARC Data Elements to FRBR and AACR

Appendix A contains a detailed mapping of data elements specified in the MARC bibliographic and holdings formats to the models developed for IFLA in the *Functional Requirements for Bibliographic Records* (FRBR) and for the Joint Steering Committee in *The Logical Structure of the Anglo-American Cataloguing Rules* (AACR).

Not surprisingly, there is a significant level of correspondence between the data elements specified in MARC (some 2600 in total) and the entities, attributes, and relationships defined in the FRBR and AACR models. Approximately 1200 MARC data elements can be mapped to the entities, attributes and relationships defined in the FRBR model. A slightly smaller number (approximately 1100) can be mapped to the AACR model. However, the correspondences are not in all cases exact. Approximately ten percent of the correspondences to both FRBR and AACR have to be qualified in some form or other, usually because the MARC data element comprises a mix of values pertaining to different entities or to different attributes of the same entity. Those inexact correspondences are marked in the tables in **Appendix A**, and each is annotated with an explanation of the anomaly.

Appendix B and **Appendix C** contain detailed reverse mappings of the entities, attributes and relationships defined in FRBR and AACR, respectively, to the corresponding data elements specified in MARC.

5.1 Correlation with FRBR

The reverse mapping of FRBR to MARC reveals a rather complex distribution of attributes and relationships associated with the four primary entities defined in the FRBR model (*work*, *expression*, *manifestation*, and *item*).

5.1.1 Attributes of work, expression, manifestation and item

Attributes associated with the FRBR entity *work* tend to be concentrated, as might be expected, in heading fields (100-130, 600-658, 700-754, and 800-830), title fields (240-245), and field 006/008. Within the heading and title fields attributes associated with the entity *work* are consistently designated at the subfield level. In field 006/008, however, the attributes of the FRBR entity *work* are less consistently structured. For example, the attribute "form of work" surfaces in five data elements in field 006/008 for books, in four for maps, in three for music, in three for serials, and in one for visual materials, and the positioning of those data elements differs significantly from one configuration of the field to another. Furthermore, the correlation between a particular attribute associated with *work* as defined in FRBR and the corresponding data element specified in field 006/008 is in a number of cases inexact, inasmuch as the MARC data element sometimes mixes or concatenates values for an attribute of *work* with attributes of other entities.

Attributes of the FRBR entity *expression* are recorded in textual form in a number of heading and title fields (e.g., subfield ‡l – language, subfield ‡o – arranged statement); in certain material specific fields (254, 255, and 256), in certain physical description fields (310, 321, 342 and 343), and in certain note fields (505, 514, 516, 520, 546, 562, and 586). Attributes of *expression* are recorded as fixed length data elements both in field 006/008 and in field 007. As with the attributes of *work*, the correlation between a particular attribute associated with *expression* as defined in FRBR and the corresponding data element specified in field 006/008 or 007 is in a number of cases inexact, inasmuch as the MARC data element sometimes mixes or concatenates values for an attribute of *expression* with attributes of other entities. Attributes of *expression* also occur in coded form in fields 034 (coded cartographic mathematical data), 041 (language), and 306 (playing time).

Attributes of the FRBR entity *manifestation* tend to be concentrated in the numbers fields (013, 018, 020, 022, 024, 027, 028, 030, 032, 036, 037, 074, 086, and 088), title and title-related fields (210, 222, 242,

245, 246, and 247), edition, imprint, etc. fields (250, 256, 260, and 270), and physical description fields (300, 340, 352, and 362). Attributes of *manifestation* may also occur in added entry fields (subfield ‡h – medium, and subfield ‡x - ISSN), and in an added entry field defined specifically for computer files (753). In coded form, attributes of *manifestation* occur in both field 006/008 and in field 007, as well as in field 046. As with the attributes of *work* and *expression*, the correlation between a particular attribute associated with *manifestation* and the corresponding data element specified in field 006/008 or 007 is in a number of cases inexact, inasmuch as the MARC data element sometimes mixes or concatenates values for an attribute of *manifestation* with attributes of other entities.

Attributes of the FRBR entity *item* occur primarily in call number fields (050, 051, 055, 060, 061, 070, 071, 080, 082, and 084), some numbers fields (026) and in holdings fields (852-878). Attributes of *item* may also occur in series statements (490), and in certain note fields (541, 562, 563, 583, and 585). In coded form, attributes of *item* occur in field 007 for motion pictures. Attributes that may be associated either with *manifestation* or with *item* occur in fields 355, 357, 506, 540, and 845.

5.1.2 Relationships between works, expressions, manifestations, and items

Work-to-*work* relationships are reflected in a variety of MARC data elements. Added entry fields (700-730) may contain data pertaining to a related *work*. Certain linking entry fields (770 and 772) are defined specifically to convey *work*-to-*work* relationships, while others (760-786), although not specifically defined as *work*-to-*work* relationships, may contain data associated with the related entity at the *work* level (e.g., in the form of a uniform title in subfield ‡s). A number of note fields (510, 525, 555, and 556) also contain data reflecting a *work*-to-*work* relationship.

Expression-to-*expression* relationships may appear in added entry fields (700-730), and in certain linking entry fields (765, 767, and 775).

Manifestation-to-*manifestation* relationships appear in series added entries (440, 800-830), in certain note fields (530, 533 and 534), and in a number of linking entry fields (760, 762,773, 774, and 776). *Manifestation*-to-*manifestation* relationships may also appear in added entries (700-730). Aspects of *manifestation*-to-*manifestation* relationships are also reflected in coded form in field 006/008 for serials and in field 007 for maps, globes, and computer files.

An *item*-to-*item* relationship is reflected in field 544.

5.2 Correlation with AACR

To a large extent, the reverse mapping of AACR to MARC parallels the mapping of FRBR to MARC. However, because the AACR model reflects both "real world" entities (i.e., the agents, processes, objects, etc. that are described in the catalogue record) and "bibliographic" entities (i.e., the abstract concepts that are internal to the logic of the rules themselves), the mapping to MARC data elements is more complex than the mapping from the FRBR model to MARC. In the AACR mapping, MARC data elements have been mapped to the corresponding "real world" entity in AACR where there is a correlation to one or two specific entities (e.g., *document*/*document part*), but in cases where the MARC data element correlates to multiple "real world" entities the data element has been mapped to the corresponding bibliographic entity (e.g., *item*). To facilitate comparison with the FRBR mapping, the summary that follows groups both "real world" and "bibliographic entities" from the AACR model to parallel the four primary entities defined in the FRBR model (*work*, *expression*, *manifestation*, and *item*).

5.2.1 Attributes of AACR entities paralleling work, expression, manifestation, and item

In the AACR model, there are both "real world" and "bibliographic" entities that parallel the entity defined as *work* in the FRBR. The "real world" entities *content* and *content part*, as defined in Part 1 of the AACR model, are associated with attributes such as literary form, artistic form, form of composition, nature of content, and content part descriptor, that parallel the attribute defined as form of work in FRBR. In the

mapping of AACR to MARC those attributes are correlated with fixed-length data elements in field 006/008. However, as is the case in the FRBR mapping, the correlation between the AACR attributes paralleling form of work and the corresponding fixed-length data elements in field 006/008 is uneven and in many cases inexact. In Part 2 of the AACR model there is a "bibliographic" entity defined as *work* that encompasses attributes of a *work* as they are reflected formally in headings (title of work, form of work, etc.). In the mapping of AACR to MARC, those attributes are correlated with data elements recorded in heading fields (100-130, 600-658, 700-754, and 800-830) and in certain title fields (240 and 243).

In the AACR model, there are again both "real world" and "bibliographic" entities that parallel the entity defined as *expression* in the FRBR. The "real world" entities *content* and *content part*, as defined in Part 1 of the AACR model, are associated with attributes such as content summary, extent of content part, language of content, musical presentation, scale, and projection—all of which parallel the similarly named attributes of *expression* defined in FRBR. In the mapping of AACR to MARC, those attributes are correlated with data elements in certain material specific fields (254, 255, and 256), and in a number of note fields (505, 520, and 546). A number of those same attributes are also correlated with data elements in coded form in field 006/008 (e.g., relief, format of music, and duration), and in fields 034 (scale), 041 (language), and 306 (playing time). In addition, the "bibliographic" entity defined as *class of materials* in Part 1 of the AACR model parallels in certain respects of the attribute defined in FRBR as form of expression. In the mapping of AACR to MARC class designation (an attribute of *class of materials*) is significant in that it largely determines the configuration both of field 006/008 and of field 007.

The entity defined in FRBR as *manifestation* is also paralleled by both "real world" and "bibliographic" entities in the AACR model. The "real world" entities *document*, *document part*, *infixion*, *physical carrier, container* and *collection*, as defined in Part 1 of the AACR model, are associated with a wide range of attributes that parallel attributes of *manifestation* in FRBR. In mapping AACR to MARC, those attributes tend to be concentrated (as are their FRBR counterparts) in the numbers fields (013, 018, 020, 022, 024, 027, 028, 030, 032, 036, 037, 074, 086, and 088), title and title-related fields (210, 222, 242, and 245), edition, imprint, etc. fields (250 and 260), physical description fields (300, 310, 321, 340, and 362), in certain note fields (508, 511, 515, 524, 538, 541, 550, and 583), and in holdings fields (853-865). Document and document part identifiers may also occur in added entry fields (subfield ‡x - ISSN). In coded form, attributes of *document* and *document part* occur in field 006/008, as well as in field 044, and attributes of *infixion* and *carrier* occur both in field 006/008 and in field 007. The "bibliographic" entity *item*, as defined in Part 1 of the AACR model, parallels the FRBR entity *manifestation* when it represents a *document*, *document part*, or *collection*. In the mapping of AACR to MARC, a number of data elements (most notably titles in fields 242, 245, 246, and 247, and publication/distribution dates in fields 008 and 046) are correlated with *item* rather than with *document*, *document part*, or *collection*, because they may be associated with any of those three "real world" entities, or with the AACR entity *content part*, which parallels *expression* in FRBR.

The entity defined in FRBR as *item* is paralleled by the entity defined as *copy* in the AACR model. Data elements associated with *copy*, as defined in Part 1 of the AACR model, occur in a number of fields that are specific to archival holdings (355, 357) as well as in note fields that may apply to a broader range of materials (506, 540, 541, and 562), and in one holdings field (845). In coded form, attributes of *copy* occur in field 007 for motion pictures.

5.2.2 Relationships between AACR entities paralleling work, expression, manifestation, and item

Relationships defined as *work*-to-*work* relationships in FRBR are paralleled by a number of *item*-to-*item* relationships and *content*-to-*content* relationships defined in Part 1 of the AACR model, as well as by *work*-to-*work* relationships defined in Part 2. Relevant relationships defined as *item*-to-*item* relationships in Part 1 (e.g., supplement, published index/calendar, continuation, merger, split, index) are reflected in specifically defined note fields (510, 525, 555, and 556) and linking entry fields (780 and 785). Relevant relationships defined as *content*-to-*content* relationships in Part 1 (adaptation and sequel) are not specifically defined in MARC, but would be recorded in a general note (field 500). Relevant relationships defined as *work*-to-*work* relationships in Part 2 of the AACR model may be reflected in linking entry fields (760-786) through the use of a uniform title (subfield ‡s).

Relationships defined as *expression*-to-*expression* relationships in FRBR are paralleled by *content*-to-*content* relationships defined in Part 1 of the AACR model, as well as by a *work*-to-*work* relationships defined in Part 2. The translation relationship defined in Part 1 as a *content*-to-*content* relationship and in Part 2 as a *work*-to-*work* relationship is reflected in two specifically defined linking entry fields (765 and 767), as well as in an indicator value in field 041. The revision relationship defined in Part 2 as a *work*-to-*work* relationship is also reflected in the linking entry field 767.

Relationships defined as *manifestation*-to-*manifestation* relationships in FRBR are paralleled by a number of *item*-to-*item* and *item*-to-*series* relationships defined in Part 1 of the AACR model. Those relationships are reflected in note fields (530, 533, and 534), in linking entry fields (770, 772, 773, 774, and 776), and in series added entry fields (440, 800-830). Aspects of an *item*-to-*item* reproduction relationship are also reflected in coded form in field 006/008 for serials and in field 007 for maps, globes, and computer files.

5.3 Implications for cross-sector exchange of data

The extent to which MARC data elements can be mapped to the entities, attributes, and relationships defined in the FRBR model provides some indication of the potential for developing effective cross-walks between the MARC format and data formats developed by other communities and organizations within the broader information sector. The FRBR model defines entities and relationships at a conceptual or logical level. It has been recognized fairly widely across related communities as a useful tool for understanding the nature of bibliographic data, and has had a significant influence on the development of similar models for use within those communities. **The relatively high level of correlation between MARC and the FRBR model suggests, therefore, that the level of compatibility between MARC and standards reflecting the FRBR and related models should be relatively high, at least at the logical level.**

On a practical level, the mapping of individual MARC data elements to the FRBR model can be used in the development of cross-walks to other bibliographic data formats as a means of clarifying correspondences and anomalies at a logical level that might otherwise be obscured by naming conventions and the formal structures embodied in the respective formats. The mapping serves to flag data elements in MARC that have an inexact or anomalous correspondence with the attributes and relationships defined in FRBR. It also flags data elements that require additional analysis before the correspondence with FRBR (and presumably with data defined in other bibliographic formats) can be confirmed.

The mapping of MARC to the AACR model and its parallels with the mapping to FRBR can be used as a means of making both quantitative and qualitative assessments of the degree to which the definition of the MARC format is correlated with cataloguing conventions (especially AACR). Assessments of that kind should be useful in determining, for example, the potential for extending the scope of the MARC user community to those who use standards other than AACR and the ISBD to govern the formulation of data content.

6. Extending the FRBR Model

Appendix D contains the extended FRBR model developed for this study. The extended model provides a comprehensive structured representation—at a conceptual or logical level—of all the information contained in the MARC bibliographic and holdings formats. As such, it serves as a means of clarifying the extent of information covered by the formats and the interrelationships between and among elements of that information.

The model is presented in four segments: (1) FRBR entities and primary relationships; (2) additional entities related to *work*; (3) additional entities related to *item*; and (4) "record metadata" entities.

6.1 FRBR Entities and Primary Relationships

The first segment of the extended model (**Appendix D, Figure 1, Tables 1, 1.1-1.10**) contains capsule versions of the FRBR entity-relationship diagrams, entity, attribute, and relationship definitions, supplemented with definitions for additional attributes and relationships to reflect data specified in the MARC bibliographic and holdings formats that correspond to the entities originally defined in the FRBR model.

6.1.1 Additional attributes associated with work

The extended model includes the following additional (*) attributes associated with the entity defined in FRBR as *work*, derived from the analysis of MARC data:
- nature of work*
- purpose of work*
- reading level*
- point value*
- level of interest*
- source of work*

6.1.2 Additional attributes associated with expression

The extended model includes the following additional (*) and redefined (**) attributes associated with the entity defined in FRBR as *expression*, derived from the analysis of MARC data:
- symbology*
- date of current expected frequency*
- date of former expected frequency*
- scale (extended to include scale for technical drawings/models)**
- entities and attributes*
- quality of data set*
- case file characteristics*

6.1.3 Additional attributes associated with manifestation

The extended model includes the following additional (*) and redefined (**) attributes associated with the entity defined in FRBR as *manifestation*, derived from the analysis of MARC data:
- type of component unit*
- date of production*
- place of production*
- contact information for source*
- manifestation designation*
- numbering continuity*
- calendar change for numbering*
- kind of disc, cylinder, or tape*

- system requirements (extended to include requirements for manifestations other than computer files)**
- file characteristics (extended to include compression/decompression)**
- organization and arrangement*
- quality assurance targets*
- reformatting quality*
- access instructions*
- hours of availability *

6.1.4 Additional attributes associated with item

The extended model includes the following additional (*) attributes associated with the entity defined in FRBR as *item*, derived from the analysis of MARC data:
- date of acquisition*
- method of acquisition*
- acquisition price*
- location of item*
- extent of item*
- rate of accumulation*
- completeness of item*
- reproduction restrictions on item*
- frequency of use of item*

6.1.5 Additional attributes and relationships associated with person

The extended model includes the following additional (*) attributes and relationships associated with the entity defined in FRBR as *person*, derived from the analysis of MARC data:
- biography/history*
- has custody of ⇨ item*
- affiliated with ⇨ corporate body*

6.1.6 Additional attributes and relationships associated with corporate body

The extended model includes the following additional (*) attributes and relationships associated with the entity defined in FRBR as *corporate body*, derived from the analysis of MARC data:
- address*
- biography/history*
- has custody of ⇨ item*
- affiliated with ⇨ corporate body*

6.1.7 Additional attributes associated with event

The extended model includes the following additional (*) attributes associated with the entity defined in FRBR as *event*, derived from the analysis of MARC data:
- type of event*
- time/date of event*
- location of event*

6.2 Additional Entities Related to Work

The second segment of the extended model (**Appendix D, Figure 2, Tables 2, 2.1-2.8**) introduces eight newly defined entities, derived from the analysis of MARC data, that are related directly or indirectly to the entity defined in FRBR as *work*. Three of the new entities represent activities from which a *work* may result (*task*, *project*, and *program*). Related to those three entities are one representing the *work unit* responsible for performing the activity, and two representing sources of funding for such activities

(*contract* and *grant*). The remaining two new entities represent activities in which a *work* may be used (*study program* and *curriculum*).

6.2.1 Attributes and relationships associated with task

The extended model includes the following attributes and relationships associated with the entity defined as *task*, derived from the analysis of MARC data:

- task identifier
- produces ⇨ work
- performed by ⇨ work unit
- part of ⇨ project
- funded through ⇨ contract
- funded through ⇨ grant

6.2.2 Attributes and relationships associated with project

The extended model includes the following attributes and relationships associated with the entity defined as *project*, derived from the analysis of MARC data:

- project identifier
- produces ⇨ work
- comprises ⇨ task
- part of ⇨ program
- funded through ⇨ contract
- funded through ⇨ grant

6.2.3 Attributes and relationships associated with program

The extended model includes the following attributes and relationships associated with the entity defined as *program*, derived from the analysis of MARC data:

- program identifier
- produces ⇨ work
- comprises ⇨ project
- funded through ⇨ contract
- funded through ⇨ grant

6.2.4 Attributes and relationships associated with work unit

The extended model includes the following attributes and relationships associated with the entity defined as *work unit*, derived from the analysis of MARC data:

- work unit identifier
- performs ⇨ task

6.2.5 Attributes and relationships associated with contract

The extended model includes the following attributes and relationships associated with the entity defined as *contract*, derived from the analysis of MARC data:

- contract identifier
- funds ⇨ task
- funds ⇨ project
- funds ⇨ program
- funded by ⇨ corporate body

6.2.6 Attributes and relationships associated with grant

The extended model includes the following attributes and relationships associated with the entity defined as *grant*, derived from the analysis of MARC data:
- grant identifier
- funds ⇨ task
- funds ⇨ project
- funds ⇨ program
- funded by ⇨ corporate body

6.2.7 Attributes and relationships associated with study program

The extended model includes the following attributes and relationships associated with the entity defined as *study program*, derived from the analysis of MARC data:
- study program identifier
- name of study program
- uses ⇨ work
- part of ⇨ curriculum

6.2.8 Attributes and relationships associated with curriculum

The extended model includes the following attributes and relationships associated with the entity defined as *curriculum*, derived from the analysis of MARC data:
- curriculum identifier
- uses ⇨ work
- comprises ⇨ study program

6.3 Additional Entities Related to Item

The third segment of the extended model (**Appendix D, Figure 3, Tables 3, 3.1-3.3**) introduces three newly defined entities, derived from the analysis of MARC data, that are related directly or indirectly to the entity defined in FRBR as *item*. One of the newly defined entities represents an *action* pertaining to the item; another represents the *authority* governing the *action*; and the third represents the *position* responsible for the action.

6.3.1 Attributes and relationships associated with action

The extended model includes the following attributes and relationships associated with the entity defined as *action*, derived from the analysis of MARC data:
- action identifier
- name of action
- action status
- time/date of action
- action interval
- contingency for action
- method of action
- site of action
- pertains to ⇨ item
- governed by ⇨ authority
- responsibility of ⇨ person
- responsibility of ⇨ position
- responsibility of ⇨ corporate body
- performed by ⇨ person
- performed by ⇨ position
- performed by ⇨ corporate body

6.3.2 Attributes and relationships associated with authority

The extended model includes the following attributes and relationships associated with the entity defined as *authority*, derived from the analysis of MARC data:
- citation for authority
- governs ⇨ action

6.3.3 Attributes and relationships associated with position

The extended model includes the following attributes and relationships associated with the entity defined as *position*, derived from the analysis of MARC data:
- title of position
- responsible for ⇨ action
- performs ⇨ action

6.4 "Record Metadata" Entities

The fourth segment of the extended model (**Appendix D, Figure 4, Tables 4, 4.1-4.4**) provides a schematic representation of the "record metadata" (i.e., the data about data) contained in the MARC format. The four entities represented in the "record metadata" segment of the extended model are *record*, *segment*, *field*, and *data element*. All are derived from an analysis of the data in the MARC record that has an internal focus—data that is contained primarily in the leader, coded data fields, indicators, and control subfields.

Appendix F contains a mapping of the "resource metadata" entities to data elements in the MARC 21 format. The analysis in this appendix is intended to facilitate a review of data in the MARC record that is designed to support data management, as distinct from simple information exchange.

6.4.1 Attributes and relationships associated with record

The extended model includes the following attributes and relationships associated with the entity defined as *record*, derived from the analysis of MARC data:
- record identifier
- type of record
- ownership of record
- record status
- date entered on file
- date/time of latest transaction
- bibliographic level
- language of cataloguing
- character coding scheme
- type of control
- descriptive cataloguing form
- type of entry
- encoding level
- linked record requirement
- data source
- transcribing agency
- modifying agency
- authentication source
- length of record
- base address of data
- comprises ⇨ segment
- comprises ⇨ field

6.4.2 Attributes and relationships associated with segment

The extended model includes the following attributes and relationships associated with the entity defined as *segment*, derived from the analysis of MARC data:

- segment identifier
- type of segment
- part of ⇨ record
- comprises ⇨ field

6.4.3 Attributes and relationships associated with field

The extended model includes the following attributes and relationships associated with the entity defined as *field*, derived from the analysis of MARC data:

- type of field
- length of field
- function of field
- field display constant
- note controller
- level of content designation
- form of field
- field encoding level
- part of ⇨ record
- part of ⇨ segment
- comprises ⇨ data element
- parallels ⇨ field

6.4.4 Attributes and relationships associated with data element

The extended model includes the following attributes and relationships associated with the entity defined as *data element*, derived from the analysis of MARC data:

- type of data element
- source of data element
- filing of data element
- language of data element
- level of data element
- format of data element
- compressibility of data element
- applicability of data element
- evaluation of data element
- part of ⇨ field
- references ⇨ data element

7. Mapping of MARC Data Elements to User Tasks

Appendix E contains a detailed mapping of data elements specified in the MARC bibliographic and holdings formats to a defined set of user tasks. For the purposes of this analysis user tasks are divided into three broad categories: (1) tasks pertaining to resource discovery, (2) tasks pertaining to resource use, and (3) tasks pertaining to data management. The twelve tasks are defined as follows:

Resource Discovery

Search   Search for a resource corresponding to stated criteria (i.e., to search either a single entity or a set of entities using an attribute or relationship of the entity as the search criteria).

Identify   Identify a resource (i.e., to confirm that the entity described or located corresponds to the entity sought, or to distinguish between two or more entities with similar characteristics).

Select   Select a resource that is appropriate to the user's needs (i.e., to choose an entity that meets the user's requirements with respect to content, physical format, etc., or to reject an entity as being inappropriate to the user's needs).

Obtain   Access a resource either physically or electronically through an online connection to a remote computer, and/or acquire a resource through purchase, licence, loan, etc.

Resource Use

Restrict   Control access to or use of a resource (i.e., to restrict access to and/or use of an entity on the basis of proprietary rights, administrative policy, etc.).

Manage   Manage a resource in the course of acquisition, circulation, preservation, etc.

Operate   Operate a resource (i.e., to open, display, play, activate, run, etc. an entity that requires specialized equipment, software, etc. for its operation).

Interpret   Interpret or assess the information contained in a resource.

Data Management

Identify   Identify a record, segment, field, or data element (i.e., to differentiate one logical data component from another).

Process   Process a record, segment, field, or data element (i.e., to add, delete, replace, output, etc. a logical data component by means of an automated process).

Sort   Sort a field for purposes of alphabetic or numeric arrangement.

Display   Display a field or data element (i.e., to display a field or data element with the appropriate print constant or as a tracing).

7.1 Summary of Mapping to User Tasks

The mapping of MARC data elements to user tasks reflects assumptions made in the design of the format as to the expected use of a data element either in the automated processing of the data or in the course of consultation by a user.

The table that follows provides a high-level summary of the detailed mapping of data elements contained in **Appendix E**. The table identifies broad data groups (based on the major divisions used to organize the format documentation), and for each data group provides a summary of the user tasks that the data is designed to support. A solid square (■) indicates the primary user tasks the data elements in the group are designed to support (i.e., those that appear most frequently in the mapping of individual data elements in that group to user tasks in the detailed tables in **Appendix E**). An open square (□) indicates secondary user.

Table 1: Summary of Mapping to User Tasks

Data Group	Fields	Resource Discovery				Resource Use				Data Management			
		SEARCH	IDENTIFY	SELECT	OBTAIN	RESTRICT	MANAGE	OPERATE	INTERPRET	IDENTIFY	PROCESS	SORT	DISPLAY
Leader											■		
Control fields	001-005									■	■		
Control fields	006-008		■	■	□		□	□	⊠				
Numbers and codes	010-088	■	■	□	■					□	□		
Main entries	100-130	■	■										
Title and title-related	210-247	■	■	□	■								
Edition, imprint, etc.	250-270		■	■	■			□	□				
Physical description, etc.	300-362		■	■			■	■	⊠				
Series statements	440-490	■	■	■	■								
Notes	500-586		■	■	□	□	□	□	□				
Subject access	600-658	■	■										
Added entries	700-754	■	■										
Linking entries	760-787		■	■	■								
Series added entries	800-830	■	■										
Holdings, alternate graphics, etc.	841-886		■		■	□	■						

tasks that data elements in the group are designed to support (i.e., those that appear less frequently in the mapping of individual data elements in that group to user tasks in the detailed tables in **Appendix E**). A square containing an "x" (⊠) indicates user tasks that a limited number of data elements in the group are designed to support (i.e., those that appear on an exceptional basis in the mapping of individual data elements in that group to user tasks in the detailed tables in **Appendix E**). Note that the summary table does not reflect the use of data recorded in indicators and control subfields for data management purposes.

The following general observations can be drawn from the mapping of data elements to user tasks:

- the predominant assumed use of data throughout the record as a whole is resource discovery
- the identification of a resource is the single most frequently occurring use in the mapping
- support for searching has been extended beyond the conventional parameters of descriptive and subject cataloguing to include index terms designed to serve special purposes or specific communities of users (e.g., genre, occupation, function, curriculum objective, make, model, programming language, and operating system, and taxonomic names)
- the inclusion of data to support resource use (particularly the management and operation of resources) is significant but more limited than data supporting resource discovery
- the more recent addition of data supporting interpretation is linked in large part to the description of digitally encoded content (e.g., remote sensing imagery, geo-spatial data; digital graphic representation; data quality, and entity and attribute information)