An Application Practice of the IFLA FRBR Model

A Metadata Case Study for the National Palace Museum in Taipei

Ya-ning Chen
Computing Centre, Academia Sinica. Email:arthur@sinica.edu.tw

Simon C. Lin
Computing Centre, Academia Sinica. Email:sclin@sinica.edu.tw

Shu-jiun Chen
Computing Centre, Academia Sinica. Email:sophy@sinica.edu.tw

In 1998, the Functional Requirements for Bibliographic Records（FRBR）model which is composed of four entities （work, expression, manifestation and item） and their associative relationships （primary, responsibility and subject）, was proposed by the International Federation of Library Associations and Institutions （IFLA）. The FRBR model can be deployed as a logical framework for proceeding content-based analysis and developing metadata format. This paper presents a case study of the National Palace Museum （NPM） in Taipei to examine the feasibility of the FRBR model. Based on the examination of case study at the NPM, the FRBR model is proven to be a useful and fundamental framework for content-based analysis and metadata implementation. We find that the FRBR model is helpful in identifying proper metadata elements organization and their distribution over the FRBR entities. Basically, this model is more suitable for media-centric and association-rich contents. However, in order to refine the FRBR model as a common framework for metadata, it would also require supportive mechanisms for management responsibility relationships for the workflow consideration and functionality elements for preservation purpose.

Introduction

Catalogue has been used traditionally as a means for the description of collections in library and museum communities. As the world moves into new era of digital library, metadata analysis, with its inherent dynamic and diverse features, becomes a new technique to deal with networked resources which are often in lack of structure. In order to clarify the process of metadata analysis, conceptual models could be used to help developing metadata framework, for example, the Functional Requirements for Bibliographic Records（FRBR）model（Plassard, 1998）has been applied to descriptive and rights-management metadata, the Harmony ABC model is designed to support multimedia metadata （Brickley & Lagoze, 1999）.

The National Palace Museum （NPM） in Taipei is the biggest museum of precious Chinese culture collection in the world. Most of its collection is inherited from the imperial court of Ch'ing Dynasty. There are over 10 thousands pieces of Chinese painting and calligraphy alone in its collection which includes many rare Sung （AD 960） and Ming （AD 1368） artworks. Since Chinese painting and calligraphy often appear together and are created by similar means, they are often regarded as sister arts. When combined with poetry and the seal, the work is complete in form and spirit to create one of the enduring features of Chinese painting. Because of the uniqueness of the above nature, Chinese collection differs greatly from its western counterpart both in content and presentation. In this paper, we use a case study approach to examine the feasibility of the FRBR model for the metadata framework on Chinese painting and calligraphy at the NPM.

Practices of the FRBR model

The FRBR model was proposed by the IFLA in 1998, and caused much discussion especially in digital library domain. It is deserved to be explored about applying this model for digital library systems and services. This section will review the FRBR model, and then discuss the application of FRBR model to three selected cases.

The FRBR model

The FRBR model is the research result of the IFLA Study Group on the FRBR using entity-relationship （ER） modeling to build up a conceptual model for bibliographic records. The model was approved by the Standing

Paper presented at The 65th Annual Meeting of the American Society for Information Science & Technology, Philadelphia, USA

Committee of the IFLA Section on Cataloguing in 1997. There are four entities in the model including WORK, EXPRESSION, MANIFESTATION, and ITEM. There are also three relationships, namely, primary, responsibility and subject relationships associated with the four entities. These concepts are illustrated in Figure 1,2,3 （Plassard, 1998, pp. 13-15）. WORK and EXPRESSION are defined to reflect intellectual or artistic content; MANIFESTATION and ITEM are to reflect physical form. In the case of subject relationship, the FRBR model represents a set of entities that serve as the subjects of works which may include concept, object, event, and place.

M. Day （1998） has conducted a research on the comparison of Dublin Core, FRBR model, and Common Information System in terms of data modeling. Furthermore, he offered a comparative table of FRBR entity with proposed attributes and Dublin Core label. He also emphasized six types of relations from the FRBR model including *created by, embodied in, exemplified by, has a subject, realized by, and realized through relationships*.

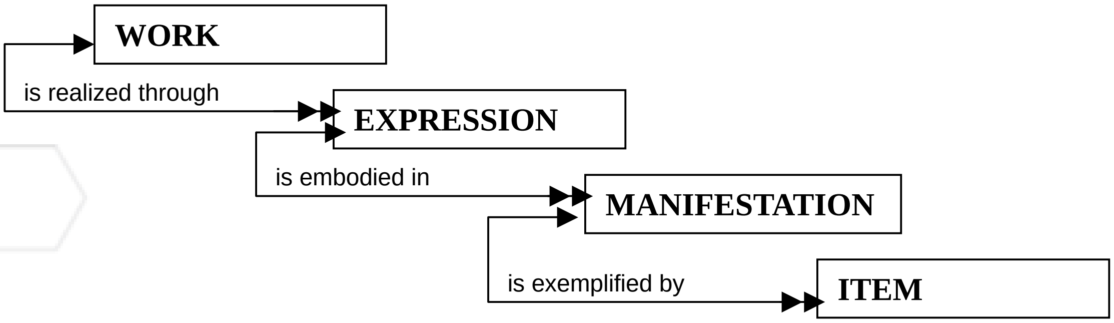

WORK
is realized through
EXPRESSION
is embodied in
MANIFESTATION
is exemplified by
ITEM

Figure 1: Entities and “primary” relationships [based on IFLA FRBR Figure 3.1]

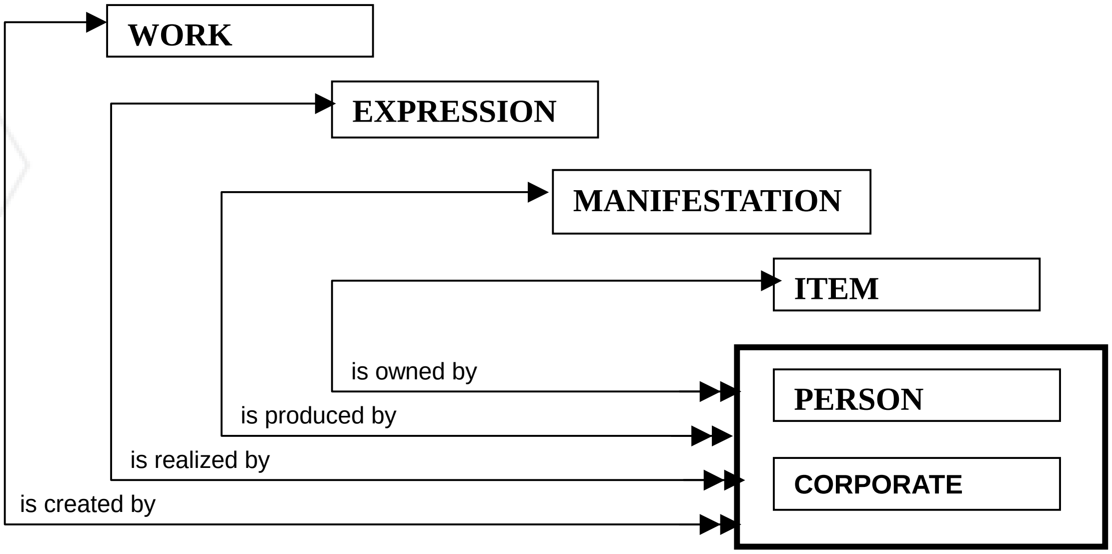

WORK
EXPRESSION
MANIFESTATION
ITEM
is owned by
is produced by
is realized by
is created by
PERSON
CORPORATE

Figure 2: Entities and “responsibility” relationships [based on IFLA FRBR Figure 3.2]

MAAT
Metadata Architecture and Application Team

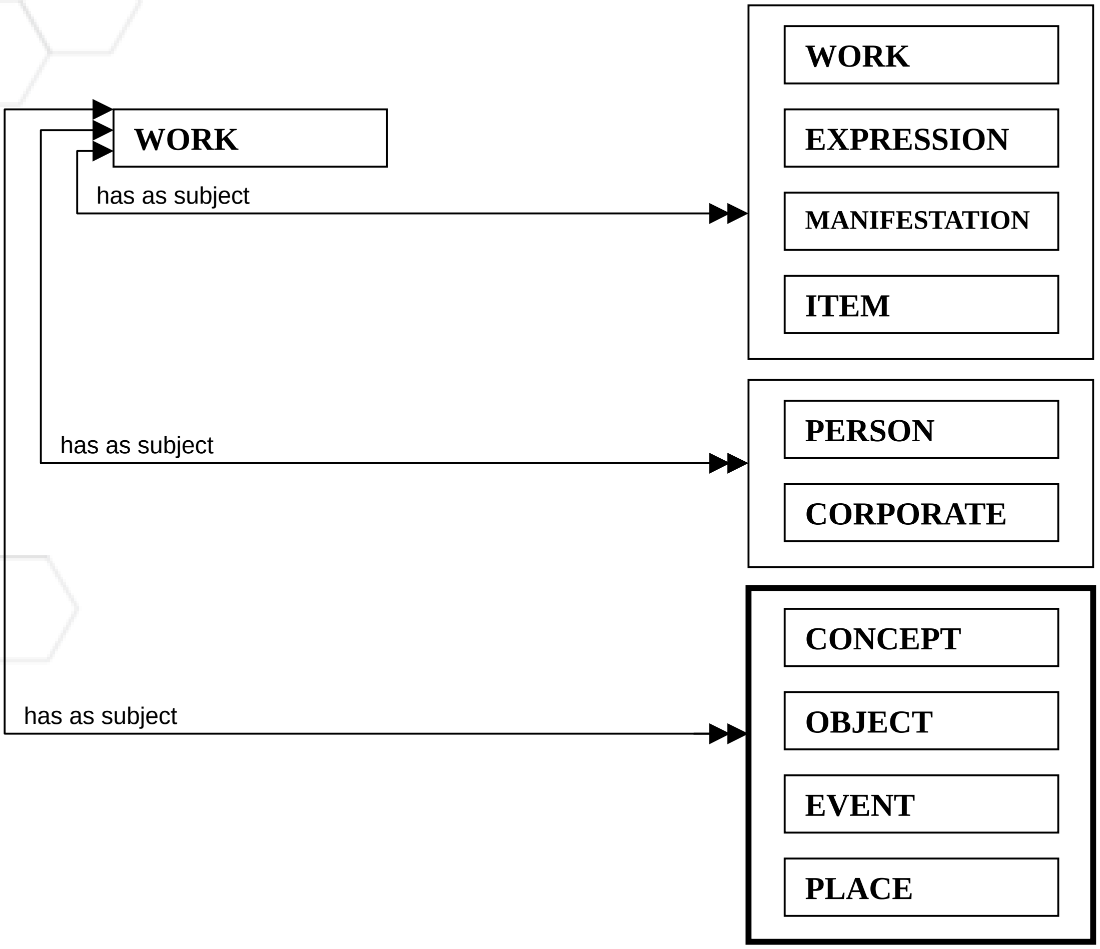


Figure 3: Entities and “subject” relationships [based on IFLA FRBR Figure 3.3]

The FRBR model has been defined by four entities associated with three kinds of relationships （primary, responsibility, and subject relationship）, however, the issue that how to implement them as a real IT system is not given. In 1995, Heaney developed three models based on object-oriented （OO） approach for cataloging, and these models are TEXT, PUBLICATION, and COPY model. According to Heaney’s conceptual definitions, the TEXT model is strings of sentences, the PUBLICATION model of reformatting and republication is to cover attributes of publication, and publication is a particular text object that can be embedded in a publication. As for the COPY model, Heaney further explains that every copy has its own characteristics, and it embodies all of the characteristics inherited from the PUBLICATION model, which in turn embodied those inherited from the text model. In the COPY model, Heaney exemplifies that functions such as loan, reservation and sending for binding can be operated in the copy model （Heaney, 1995, pp. 140-142）. Obviously, the FRBR model is more general than Heaney’s OO models since the *inheritance* is not required in the four entities of FRBR model. One may find that EXPRESSION entity is identical to the TEXT model, MANIFESTATION is identical to the PUBLICATION model, and ITEM is identical to the COPY model, if *explicit inheritance* is required in the FRBR model.

With the understanding of Heaney’s approach, one may use the FRBR model as a conceptual framework for developing metadata system suitable for effective indexing. Firstly, these entities and relationship can be considered as a basic structure for record representation. Secondly, entities and their metadata elements could be used as a basis for system development in light of indexing key, record structure, access point, and so on. Thirdly, the manifestation entity is helpful to record the transfer of intellectual property rights. Fourth, the item entity is useful for operation considerations, such as circulation, collection management, transfer of ownership of physical format, etc.

Selected case studies

It becomes popular to adopt the FRBR model as a foundation framework for proceeding metadata analysis and developing metadata format. Three selected cases are chosen to review the state-of-the-art on the FRBR model practices in metadata development. First is the European CHronicles On-line （ECHO） Project in European Union IST Programme, second is the INteroperability of Data in E-Commerce Systems （INDECS） Project in Info 2000 Programme, and third is the “digital rights management architectures” that raised by R. Iannela at IPR Systems in Australia.

a. *The ECHO Project*

The ECHO Project aims at developing a long-term reusable software infrastructure and new metadata models for films in order to support the development of interoperable audiovisual digital libraries. The project is funded by the European Community within the Fifth Framework Program which was launched in 2000 and its completion is expected by 2002 （Savino, 2000）. As the recognition of the fact, that metadata elements as presently defined, does not describe film information well, therefore, the ECHO Metadata Model has been developed to address the problem of devising new metadata elements to better describe film information as well as automating the metadata analysis.

The ECHO Metadata Modelling Report was generated in 2000 which was composed of two key parts: ECHO metadata model and ECHO metadata fields. Four entities of the FRBR model in the ECHO Project are interpreted into （WORK ↔ **AV-DOCUMENT**）, （EXPRESSION ↔ **VERSION : VIDEO / AUDIO / TRANSCRIPT**）, （MANIFESTATION ↔ **MEDIA**）, and （ITEM ↔ **STORAGE**）（Amato, Castelli, Pisani, Venerosi, Poncin & Vinet, 2000, p. 15）. Obviously, some points of explanation are in order:

- ECHO metadata model is built on the FRBR model with the corresponding *AV-DOCUMENT, VERSION, MEDIA,* and *STORAGE* entities to support digital films archives.
- The construction of ECHO metadata fields are based on the *media-centric* approach for audiovisual resources metadata both in traditional and digital format.

b. *The INDECS Project*

The <INDECS> project was established at the end of 1998 with support from the European Commission, which stands for INteroperability of Data in E-Commerce Systems. It is recognized from the outset that metadata would be generated in diverse ways and by diverse players in the value chain （Framework Ltd., 2000）. The initial goal of the <INDECS> Project focuses on intellectual property rights and the Project uses the FRBR model as a logical foundation and framework for metadata development and implementation. Some revisions are proposed, subsequently, to achieve the <INDECS> Project’s requirements as in the following:

- Instead of a clear division of *MANIFESTATION* and *ITEM*, the <INDECS> Project integrates these two entities into *one* in order to meet the requirements of intellectual property rights.
- The <INDECS> Project also emphasizes on the **equal importance** of *information resource, agents and actions, time,* and *place* in order to formulate the <INDECS> model （Bearman, Miller, Rust, Trant & Weibel, 1999）.

c. *Digital rights management*（DRM）*architectures*

According to results of the <INDECS> Project, Iannella extends “DRM architecture” into two components: functional architecture, and information architecture. In the light of the information architecture, the FRBR model is used as a framework to define the content and expression models as well as their statements as below:

- The IFLA FRBR model allows content to be identified at the WORK, EXPRESSION, MANIFESTATION, and ITEM layers. In each of these layers, *different rights and rights holders* may need to be supported.
- Another aspect that may affect rights is when CONTENT is made of many parts. Some of these parts may have *different rights associated with them* that need to be recognized in the aggregated content（Iannella, 2001）.

One may draw conclusion based on the above studies:

- It is useful to adopt the FRBR model as a base model of metadata framework for different purposes and clarify relationship among diverse entities, such as person, event, time, space, thing attributes.
- The focus of the FRBR model is on functionality of material （i.e. thing）for bibliographic records. T. Gill in the Research Libraries Group also finds the similar result （Gill, 2000）. It uses an integrated approach of surrogate-based and ER modeling to define relationships associated with entities to re-examine and enrich functions of library catalog. Then, other typical attributes such as person, event, time-span, and place name become supportive entities, therefore, they are not parallel to thing attribute in this model.

A case study and result: Chinese painting and calligraphy at the NPM

The NPM in Taipei owns a lot of Chinese paintings and calligraphies from the Ancient China Emperors. Before 1999, the NPM had developed a system for managing these collections. Since 1999, the NPM devoted to the Digital Museum Project in Taiwan and adopted a DC-based standard as a metadata format for Chinese collections, i.e. MICI （Metadata Interchange for Chinese Information）. With the initiated preparation of the National Digital Archives Program in Taiwan in 2002, the Metadata Architecture and Application Team （MAAT） at the Computing Centre of Academia Sinica is invited to design metadata for two projects at the NPM. One is for "Chinese painting and calligraphy," and the other is "Chinese antiques." The practice of FRBR model on Chinese painting and calligraphy will be selected as a case study to examine the appropriateness of this model, including entities and primary relationship, entities and responsibility relationships, and entities and subject relationships.

Entities and primary relationships

The FRBR model is composed of four layers （work, expression, manifestation, and item） in order to represent the different aspects of user interests in the products of intellectual or artistic endeavour （Plassard, 1999, p. 12）. Firstly, we apply the FRBR as a framework to illustrate the relationship between various objects for different layers. Based on the FRBR model, two types of objects at the NPM are required to draw a clear line: original and duplication ranging from slides, photos, to digital images. Up to date, the Categories for the Description of Works of Art （CDWA） that developed by the J. Paul Getty Trust and the College Art Association is selected as a metadata format for this project. Next, metadata elements of CDWA are allocated into layers （as shown in Table 1）. Entirely, pattern of primary relationship is proven as same results as the FRBR model: *is realized through, is embodied in, and is exemplified by*.

Besides a relationship for a single object, several objects also exist a seamless relation. Therefore, a single object identity in the FRBR model is expanded into multiple identities in order to delineate the rich association between related objects. This clear delineation of association is useful as a reference to metadata record's separation and their linkages. According to the IFLA results, relationships between entities can be generalized into two types: *vertical* and *horizontal*. The *vertical relationship* is used to describe the relation between *different entities* at various levels, that is, "WORK to EXPRESSION to MANIFESTATION to ITEM." On the other hand, the *horizontal one* is deployed to indicate the relation for *same identity* at the same layer, that is, "WORK to WORK," "EXPRESSION to EXPRESSION," "MANIFESTATION to MANIFESTATION," and "ITEM to ITEM." Based on verification of Chinese painting and calligraphy at the NPM, one finding is interesting that all relationships both of horizontal and vertical are partially applied at different entities to this case as follows （as shown in Table 2, 3, 4）:

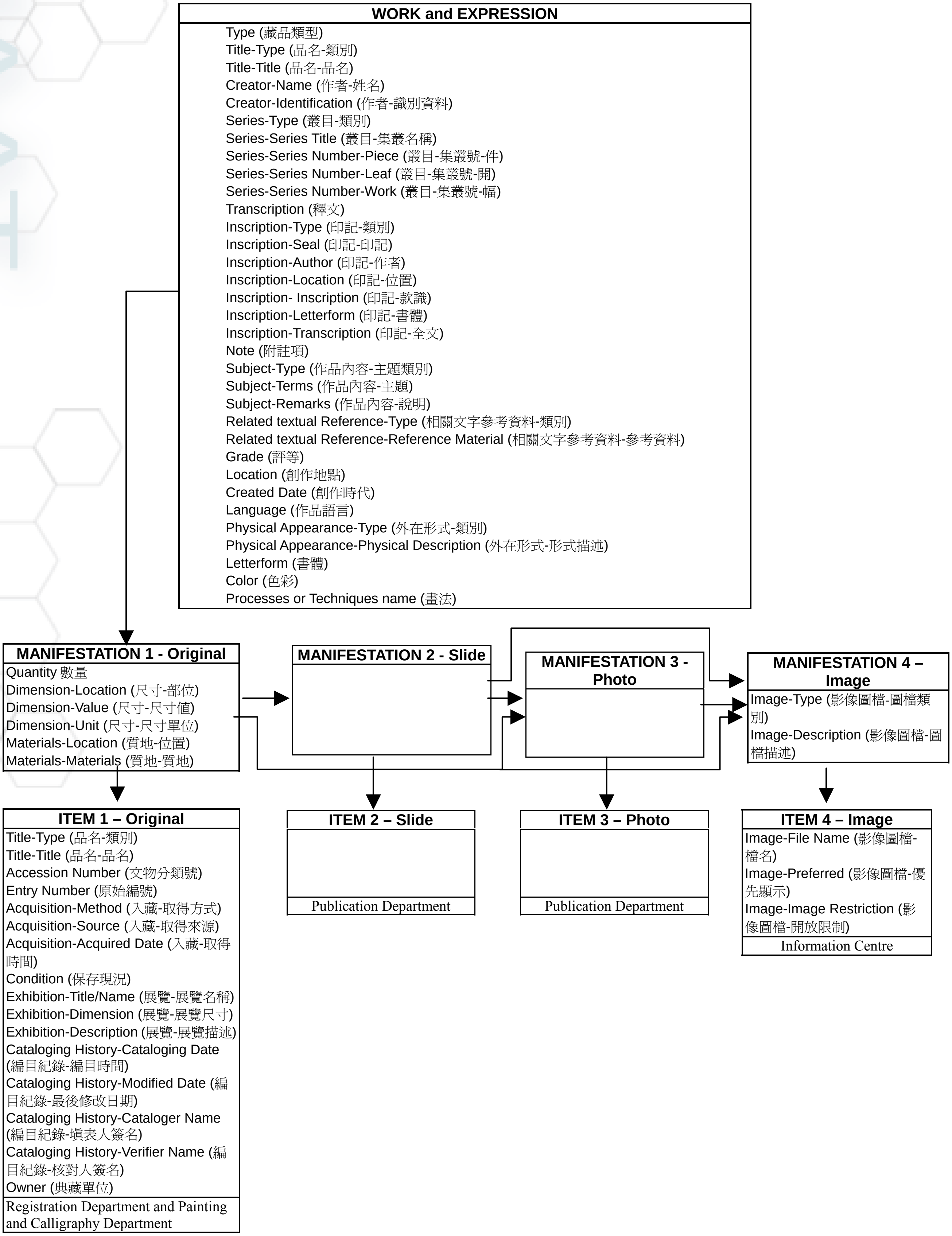
- *Horizontal relationship*
  a. WORK: successor （i.e. related series）, supplement（i.e. appendix）, and whole/part（i.e. series）.
  b. EXPRESSION: successor, supplement, whole/part, and reproduction （i.e. image）.
  c. MANIFESTATION: whole/part, reconfiguration, and reproduction.
  d. ITEM: reconfiguration, reproduction, and whole/part.
- *Vertical relationship*: reproduction.

Entities and responsibility relationships

The responsibility relationships in the FRBR model are depicted the relationship between two groups of entities: "work, expression, manifestation, and item," and "person and corporate body." In other words, the responsibility aims to clarify the role's function to work, expression, manifestation, and item. Therefore, four types of responsibility are defined by the IFLA in order: *is created by, is realized by, is produced by, and is owned by*. In the case at the NPM, over two responsibility relationships are employed, but one is not revealed so obviously, that is "*is produced by,*" and is treated as default value for duplicate counterparts at the NPM. Although "*is realized by*" exists in the NPM case, there is no corresponsive metadata element for this relationship. The *"is realized by"* relationship is merged into "*is created by*" one. Consequently, only three metadata elements for responsibility relationship are demanded for: *creator* （both for *is created by*, and *is realized by*）, *owner* （*is owned by*）, and *producer* （*is produced by*）.

MAAT
Metadata Architecture and Application Team

Table 1. A FRBR-based metadata format for the NPM



WORK and EXPRESSION

Type (藏品類型)
Title-Type (品名-類別)
Title-Title (品名-品名)
Creator-Name (作者-姓名)
Creator-Identification (作者-識別資料)
Series-Type (叢目-類別)
Series-Series Title (叢目-集叢名稱)
Series-Series Number-Piece (叢目-集叢號-件)
Series-Series Number-Leaf (叢目-集叢號-開)
Series-Series Number-Work (叢目-集叢號-幅)
Transcription (釋文)
Inscription-Type (印記-類別)
Inscription-Seal (印記-印記)
Inscription-Author (印記-作者)
Inscription-Location (印記-位置)
Inscription- Inscription (印記-款識)
Inscription-Letterform (印記-書體)
Inscription-Transcription (印記-全文)
Note (附註項)
Subject-Type (作品內容-主題類別)
Subject-Terms (作品內容-主題)
Subject-Remarks (作品內容-說明)
Related textual Reference-Type (相關文字參考資料-類別)
Related textual Reference-Reference Material (相關文字參考資料-參考資料)
Grade (評等)
Location (創作地點)
Created Date (創作時代)
Language (作品語言)
Physical Appearance-Type (外在形式-類別)
Physical Appearance-Physical Description (外在形式-形式描述)
Letterform (書體)
Color (色彩)
Processes or Techniques name (畫法)

MANIFESTATION 1 - Original

Quantity 數量
Dimension-Location (尺寸-部位)
Dimension-Value (尺寸-尺寸值)
Dimension-Unit (尺寸-尺寸單位)
Materials-Location (質地-位置)
Materials-Materials (質地-質地)

MANIFESTATION 2 - Slide

MANIFESTATION 3 - Photo

MANIFESTATION 4 – Image

Image-Type (影像圖檔-圖檔類別)
Image-Description (影像圖檔-圖檔描述)

ITEM 1 – Original

Title-Type (品名-類別)
Title-Title (品名-品名)
Accession Number (文物分類號)
Entry Number (原始編號)
Acquisition-Method (入藏-取得方式)
Acquisition-Source (入藏-取得來源)
Acquisition-Acquired Date (入藏-取得時間)
Condition (保存現況)
Exhibition-Title/Name (展覽-展覽名稱)
Exhibition-Dimension (展覽-展覽尺寸)
Exhibition-Description (展覽-展覽描述)
Cataloging History-Cataloging Date (編目紀錄-編目時間)
Cataloging History-Modified Date (編目紀錄-最後修改日期)
Cataloging History-Cataloger Name (編目紀錄-填表人簽名)
Cataloging History-Verifier Name (編目紀錄-核對人簽名)
Owner (典藏單位)

Registration Department and Painting and Calligraphy Department

ITEM 2 – Slide

Publication Department

ITEM 3 – Photo

Publication Department

ITEM 4 – Image

Image-File Name (影像圖檔-檔名)
Image-Preferred (影像圖檔-優先顯示)
Image-Image Restriction (影像圖檔-開放限制)

Information Centre

Table 2. Relationships to Persons and Corporate Bodies (✓ yes ×no)

Entities	Relationship Type	NPM Metadata
Work	is created by	✓Creator
Expression	is realized by	✓Creator
Manifestation	is produced by	✓
Item	is owned by	✓Owner

Table 3 Horizontal Entity Relationships (✓ yes ×no)

Entities Relationship		Relationship Type	NPM Metadata
Work-to-Work Relationships		Successor has a successor→ ←is a successor to ▪ Referential Work：Sequel ▪ Autonomous Work：Sequel, Succeeding work	✓ Related Series
		Supplement has a supplement→ ←supplements ▪ Referential Work：Index, Concordance, Teacher's guide, Gloss, Supplement, Appendix ▪ Autonomous Work：Supplement, Appendix	✓ Appendix
		Complement has a complement→ ←complements ▪ Referential Work：Cadenza, Libretto, Choreography, Ending for unfinished work ▪ Autonomous Work：Incidental music, Musical setting for a text, Pendant	×
		Summarization has a summary→ ←is a summary of ▪ Autonomous Work：Digest, Abstract	×
		Adaptation has adaptation → ←is an adaptation of ▪ Autonomous Work：Adaptation, Paraphrase, Free translation, Variation (music), Harmonization (music), Fantasy(music)	×
		Transformation has a transformation → ←is a transformation of ▪ Autonomous Work：Dramatization, Novelization, Versification, Screenplay	×
		Imitation has an imitation → ←is an imitation of ▪ Autonomous Work：Parody, Imitation, Travesty	×
Whole/Part Work-to-Work Relationships		Whole/part has part → ←is part of ▪ Dependent Part：Chapter, Section, part, etc. Volume/issue of serial Intellectual part of a Multipart work Illustration for a text Sound aspect of a film ▪ Independent Part：Monograph in a series, Journal article, Intellectual part of a Multipart work	✓Series
Expression-to-Expression Relationships	Between expressions of the same work	Abridgement has an abridgement → ←is an abridgement of ▪ Autonomous Expression：Abridgement, Condensation, Expurgation	×
		Revision has a revision → ←is a revision of ▪ Autonomous Expression：Revised edition, Enlarged edition, State (graphic)	×
		Translation has a translation → ←is a translation of ▪ Autonomous Expression：Literal translation, Transcription (music)	×
		Arrangement (music) has an arrangement→ ←is an arrangement of ▪ Autonomous Expression：Arrangement (music)	×
	Between expressions of different works	Successor has a successor→ ←is a successor to ▪ Relationship Expression：Sequel ▪ Autonomous Expression：Sequel, Succeeding work	✓
		Supplement has a supplement→ ←supplements ▪ Relationship Expression：Index, Concordance, Teacher's guide, Gloss, Supplement, Appendix ▪ Autonomous Expression：Supplement, Appendix	✓
		Complement has a complement→ ←complements ▪ Relationship Expression：Cadenza, Libretto, Choreography, Ending for unfinished work ▪ Autonomous Expression：Incidental music, Musical setting for a text, Pendant	×

MAAT
Metadata Architecture and Application Team

Entities Relationship	Relationship Type	NPM Metadata
	Summarization has a summary→ ←is a summary of ▪ Autonomous Expression：Digest, Abstract	×
	Adaptation has an adaptation → ←is an adaptation of ▪ Autonomous Expression：Adaptation, Paraphrase, Free translation	×
	Transformation has a transformation → ←is a transformation of ▪ Autonomous Expression：Dramatization, Novelization, Screenplay	×
	Imitation has an imitation → ←is an imitation of ▪ Autonomous Expression：Parody, Imitation	×
Whole/Part Expression-to-Expression Relationships	Whole/part has part → ←is part of ▪ Dependent Part：Table of contents, etc. Volume/issue of serial, Illustration for a text, Sound aspect of a film, Amendment ▪ Independent Part：Monograph in a series, Journal article, Intellectual part of a Multipart work	✓
Manifestation-to-Manifestation Relationships	Reproduction has a reproduction→ ←is a reproduction of ▪ Manifestation：Reproduction, Microreproduction, Macroreproduction, Reprint, Photo-offset reprint, Facsimile, Mirror site	✓Image
	Alternate has an alternate→ ←is an alternate to ▪ Manifestation：Alternate format, Simultaneously released edition	×
Whole/Part Manifestation-to-Manifestation Relationships	Whole/part has part → ←is part of ▪ Manifestation ： Volume of a multivolume manifestation, Soundtrack for a film on separate Medium Soundtrack for a film embedded in film	✓
Item-to-Item Relationships	Reconfiguration has a reconfiguration→ ←is a reconfiguration of ▪ Item：Bound with, Split into, Extracted from	✓
	Reproduction has a reproduction→ ←is a reproduction of ▪ Item：Reproduction, Microreproduction, Macroreproduction, Reprint, Photo-offset reprint, Facsimile	✓
Whole/Part Item-to-Item Relationships	Whole/part has part → ←is part of ▪ Item：Physical component of copy, Binding of a book	✓

Table 4.Vertical Entity Relationships (✓ yes ×no)

Entities Relationship	Relationship Type	NPM Metadata
Expression-to-Work Relationships	Successor has a successor→ ←is a successor to ▪ Referential Work：Sequel ▪ Autonomous Work：Sequel, Succeeding work	×
	Supplement has a supplement→ ←supplements ▪ Referential Work：Index, Concordance, Teacher's guide, Gloss, Supplement, Appendix ▪ Autonomous Work：Supplement, Appendix	×
	Complement has a complement→ ←complements ▪ Referential Work：Cadenza, Libretto, Choreography, Ending for unfinished work ▪ Autonomous Work：Incidental music, Musical setting for a text, Pendant	×
	Summarization has a summary→ ←is a summary of ▪ Autonomous Work：Digest, Abstract	×

Entities Relationship	Relationship Type	NPM Metadata
	Adaptation has an adaptation → ←is an adaptation of ▪ Autonomous Work：Adaptation, Paraphrase, Free translation, Variation (music)	×
	Transformation has a transformation → ←is a transformation of ▪ Autonomous Work：Dramatization, Novelization, Screenplay	×
	Imitation has an imitation → ←is an imitation of ▪ Autonomous Work：Parody, Imitation	×
Manifestation-to-Item Relationships	Reproduction has a reproduction→ ←is a reproduction of ▪ Manifestation：Reproduction, Microreproduction, Macroreproduction, Reprint, Photo-offset reprint, Facsimile	×

Entities and subject relationships

In the FRBR model, the IFLA has defined a work with "*has as subject*" relationship between work, expression, manifestation, item, person, corporate body, concept, object, event and place, in order to indicate the subject attribute among various entities. In the NPM case, several distinctive compromises are made to reflect for the project requirements as same as the IFLA's suggestions （Plassard, 1998, pp. 4-5）, and are listed as follows:

- The *person* and *place* subject relationships are separated into two independent *authority files*, that is, person and place names. As for the place names, geo-spatial information system is integrated to achieve the function for geo-spatial representation.
- *Time* is not included in the FRBR model, but there is a strong request for *temporal* metadata elements and authority file in arts. Therefore, *a temporal metadata authority file* for Chinese arts is under development for this requirement.

Findings

The application of FRBR model is thus proved as an extremely useful conceptual model to clarify metadata elements and their relationships based on an examination of the NPM practice. In this section, several findings will be addressed for the FRBR model in light of content analysis, as well as system implementation.

An identification of distribution of metadata elements for four entities

The FRBR model is useful as an analysis ground to identify needs for metadata element. In the NPM case, we allocate all metadata elements into four entities （WORK, EXPRESSION, MANIFESTATION, and ITEM）. Two findings are proven to be practical for extending the breadth of the FRBR model as below:

- Firstly, an advice is offered to review of metadata based on a distribution of metadata elements across over four entities. The distributed table reveals the preference for metadata elements across over entities in the FRBR model.
- Secondly, two relationships are often disregarded, that is *EXPRESSION to MANIFESTATION*, and *MANIFESTATION to MANIFESTATION*. Although the relationship between EXPRESSION and MANIFESTATION is not defined in the FRBR model, this relationship indeed exists. Based on a case at the NPM, several metadata elements（as shown in **Table 2**）are skipped from EXPRESSION to MANIFESTATION and diverse MANIFESTATIONS directly. One instance in the NPM case always occurs to those elements for slide, photo, and digital image, and *all* are combined into *an original MANIFESTATION entity*, not into *different MANIFESTATIONs* at the same level during a transferring from EXPRESSION to MANIFESTATION entity. Therefore, these two relationships are essential to identify the related elements in terms of content-based analysis.

An advise on re-organizing metadata elements

Besides an analytical table of metadata elements distribution, an analysis covering facets of person, thing, time, space, and event is also supportive to examine the expected requirements against allocation of metadata element. These two tables are helpful in verifying arrangement as follows:

- At different entities in the FRBR model, a table for elements distribution indicates the *significance priority* for each entity. If result is not matched with project's expectation, another arrangement is required to revise over again.
- Elements across five facets also reveal the *project priority* for metadata requirements. Originally, project requirements at the NPM are focused on *thing* and *person*. Then an examination is taken to justify whether metadata elements are fit for these requirements both of thing and person objects at the same time.

Functionality of metadata elements

Basically the FRBR model is proposed as a common framework, and then four functions are also defined in a theoretical manner with a variety of instructive exemplars based on *bibliographic record unit* （Plassard, 1998, pp. 100-111）. In terms of a practice for metadata analysis and system implementation, the FRBR model is beneficial to analyze the metadata elements and their relationships at four entities. Further, these instructive exemplars with explanations are also useful to clarify function for each metadata element. On the other hand, any projects will meet an issue of requesting other specific comprehensive functionality （like preservation, rights management, system management, exhibition, and so forth） based on an adoption of this model. Therefore, a variety of *functionality metadata elements sets* are required to strengthen the breadth of feasibility for the FRBR model from metadata perspective.

A media-centric and association-rich approach

The FRBR model aims originally to develop a logic framework for bibliographic record, nevertheless, that bibliographic record is supposed to cover a variety of materials included textual, music, cartographic, audio-visual, graphic, three-dimensional materials. They can cover the full range of physical media （paper, film, magnetic tape, optical storage media, etc.） described in bibliographic record, also cover all formats （books, sheets, discs, cassettes, cartridges, etc.), and reflect all modes of recording information （analogue, acoustic, electric, digital, optical, etc.）（Plassard, 1998, pp. 7-8）. The FRBR model adopts a "*surrogate* or *aboutness*" approach that Burnet et al. proposed in 1999 to analyze a range of entities and relationships for bibliographic records （Burnet, Ng & Park, 1999, pp. 1209-1213）. Its purpose is to re-examine the appropriateness of the cataloguing theory and practice. The model could be extended to cover the additional information that is normally recorded in authority records （Plassard, 1998, pp. 7-8）.

Basically, the FRBR model is still a *media-centric* and *association-rich* approach, though entities and their relationships have been defined. One may also find that the FRBR model could extend its focus into *person*, *event*, *time* and *space*, as well as their *relationships* at the same level after an examination of the NPM practice. In effect, *inheritance* is an unspecified characteristic in FRBR model, so *a reciprocal connection* of metadata elements between entities would be achieved in a seamless way if ad-hoc inheritance were introduced. It could be convenient and cost-effective for end users in terms of data creation and record representation since metadata elements needn't repeat the same elements structure based on the feature of *inheritance*. Otherwise, it may become a challenging task for system architecture, indexing, linkage, and so on.

An ambiguous distinction between entities

During the analysis process, a problem has been raised in distinguishing whether collector's seal （收藏印記） element is located at work or item entity in the FRBR model for the practice of Chinese painting and calligraphy. From the perspective of FRBR model, the element of collector's seal is for recording the transferring of ownership, so it can be included into item entity. From the researcher's perspective at the NPM, collector's seal is considered as an important part of Chinese painting and calligraphy, and it can be located in work entity. In order to solve this problem, two options based on an analysis of the FRBR model are offered. Firstly, collector's seal is separated into another independent database of seals and a linkage between them is also created. Secondly, this element is included into work entity. Of course, this issue has no conflict with our analysis since our approach actually allows for the choice and thus the resolution of the ambiguity. Eventually, researchers at the NPM chose the second option.

A lack of workflow consideration

An examination of case study at the NPM, we also find that relationships between entities are insufficient for system implementation. An original artwork at the NPM has three types of duplicate counterparts: slide, photo, and digital image. Each duplication work is managed and belonging to different departments. A clear sequent flow for these duplicate works and departments is requisite to refine context for relationships in the FRBR model. Therefore, two relationships are required in terms of the NPM case. One defined by the FRBR model is that contains a wide range of relationships for four entities, such as from a *single* MANIFESTATION （original artwork） to *different* MANIFESTATIONS （slide, photo, digital image）. The other is proposed for covering different aspects of "*management responsibility relationship*" ranging from the Painting and Calligraphy Department for research and exhibition, the Registration Department for inventory, the Publication Department for publishing, to the Information Centre for management and archiving of digital image （as shown in Figure 4）.

Related issues

Besides the above findings based on a case study examination for the NPM, two issues are deserved to explore, though they are not covered in the FRBR model. These issues will bring fundamental impacts on any digital projects, especially on metadata matter.

MAAT
Metadata Architecture and Application Team

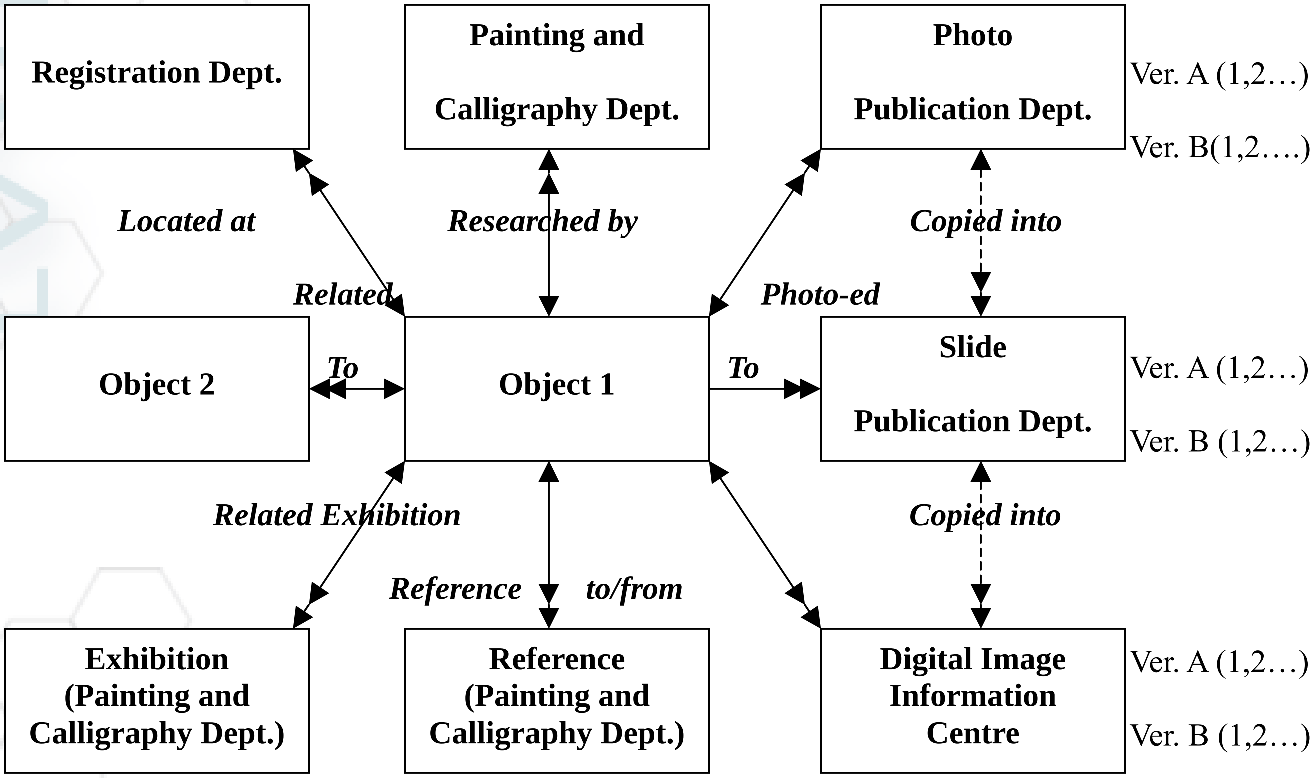

Registration Dept.
Painting and Calligraphy Dept.
Photo Publication Dept.
Ver. A (1,2…)
Ver. B(1,2….)
Located at
Researched by
Copied into
Related
Photo-ed
Object 2
To
Object 1
To
Slide Publication Dept.
Ver. A (1,2…)
Ver. B (1,2…)
Related Exhibition
Copied into
Reference
to/from
Exhibition (Painting and Calligraphy Dept.)
Reference (Painting and Calligraphy Dept.)
Digital Image Information Centre
Ver. A (1,2…)
Ver. B (1,2…)

Figure 4: A workflow context for the NPM

A tension between a generic and a comprehensive approach to metadata formats

At present, a principle adopted by the NPM case is to employ the Dublin Core （DC） and another one domain-specific standard （i.e. CDWA） at the same time for the purpose of standardization and crosswalk. In essence, the DC Elements Set is very *simple* and popular accepted, and vice versa is also *a highly conceptual metadata set* served as a common crosswalk ground for mapping and federated meta-search across a diverse of disciplinary domains. On the other hand, one may also find that the DC is too ambiguous for most of research-oriented digital library projects. However, a principle of adopting both of the DC and another specific comprehensive metadata standard simultaneously is deployed. This two-parallel principle to standardization can bring two obvious benefits in order:

- A common interface with a federated meta-search engine across various metadata standards and systems can be developed for a wider range of digital projects.
- A precise crosswalk between different metadata formats can be achieved.

Furthermore, there is a mapping conducted between CDWA and MICI according to a structured DC-basis, in order to build a transparent linkage for CDWA and MICI.

Information granularity

Basically, how to distinguish and construct *a bibliographic record unit* is an ordinary issue for any cataloguing professionals. Library always defines own best practice and principles to solve this issue and attain quality consistency, but none of a generic principle or best practice is suitable for all libraries around the world. Although four entities are clearly defined based on an ER modeling approach, how to distinguish from various works still exists and is without any substantial suggestions or practices in the FRBR model. In a case study of the NPM, the same issue also becomes a problematic issue for metadata design. Two practical cases are often raised out: one is several paintings of different themes can be put at the same piece, and the other is the same thematic paintings may across over more than two pieces. To date two types are categorized for Chinese painting and calligraphy at the NPM: one is oriented to *physical object*, and another is focused on *content-based theme*. In terms of metadata record and system, the state-of-the-art principle for "*information granularity*" at the NPM is based on *content-based theme*. Further, one relationship linkage both for *content-based theme* and *physical object* is also constructed to represent the diverse associations. However, a common principle for a unit of information granularity is still deserved to explore with a board range of case studies and practices, because this issue will heavily impact on interoperability matters including mapping and search.

Conclusion

In terms of a case study at the NPM, one may find that the FRBR model is useful as a fundamental framework to analyze for content-based analysis and metadata implementation. Then, the FRBR model is proven to be suitable for media-centric and association-rich contents. However, this model requires other supportive mechanisms, such as management responsibility relationships for workflow consideration, and functionality metadata elements set, to refine the FRBR model as a common framework for metadata. At the same time, the two-parallel principle to metadata standardization is also beneficial to solve a tension between a generic and a comprehensive approach to metadata formats, as well as employed as a grounded mechanism for a precise crosswalk and a cross-domain across over a variety of metadata formats. Eventually, an issue of information granularity is deserved to explore a workable and generic principle.

ACKNOWLEDGEMENTS

We are especially appreciated for Miss Yi-Ting Chang's dedicated contribution to the related analyses and tables in this paper.

REFERENCES

Amato, G., Castelli, D., Pisani, S., Venerosi, P., Poncin, P., & Vinet, L. (2000). Metadata modelling report. Retrieved April 1, 2001 from http://pc-erato2.iei.pi.cnr.it/echo/public/deliv/D3-1-1%20ECHO%20Metadata%20Modelling.pdf

Bearman, D., Miller, E., Rust, G., Trant, J., & Weibel, S. (1999, January). A common model to support interoperable metadata. D-Lib Magazine, 5(1). Retrieved January 22, 1999 from http://dlib.ejournal.ascc.net/january99/bearman/01bearman.html

Brickley, D., & Lagoze, C. (1999, October). ABC: A logical model for metadata interoperability. Retrieved June 30, 2001 from http://www.ilrt.bris.ac.uk/discovery/harmony/docs/abc/abc_draft.html

Burnett, K., Ng, K.B., & Park, S. (1999, November). A comparison of the two traditions of metadata development. Journal of the American Society for Information Science, 50(13), 1209-1217.

Day, M. (1998). Data models for metadata: Some issues for the Dublin Core initiative (draft). Retrieved June 30, 2001 from http://www.ukoln.ac.uk/metadata/data-models/draft-report.html

Framework Ltd. (2000). The indecs project, 2000. Retrieved June 30, 2001 from http://www.indecs.org/project.htm

Gill, T. (2000). IFLA FRBR: What is it? Retrieved June 30, 2001 from http://www.cimi.org/public_docs/r_FRBR.html

Heaney, M. (1995, September). Object-oriented cataloging. Information Technology and Libraries, 14(3), 135-153.

Iannella, R. (2001, June). Digital rights management architectures. D-Lib Magazine, 7(6). Retrieved January 2, 2002 from http://dlib.ejournal.ascc.net/dlib/june01/iannella/06iannella.html

Plassard, M. (Ed.). (1999). Functional requirements for bibliographic records: Final report. Saur, Műchen: K.G. Saur. Retrieved December 24, 1998 from http://www.ifla.org/VII/s13/frbr/frbf.pdf

Savino, P. (2000, November). Building an audio-visual digital library of historical documentaries: the ECHO Project. D-Lib Magazine, 6(11). Retrieved June 30, 2001 from http://www.dlib.org/dlib/november00/11inbrief.html#SAVINO