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# **Implementing FRBR**

**A Comparison of two relational models: IFLA's FRBR model and Taniguchi's expression-prioritized model.**

**Master thesis**

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IFLA's FRBR model and Taniguchi's expression-prioritized model**

**Abstract:**

Two relational data models are implemented and compared. One is based on the FRBR model proposed by the IFLA Study Group on the Functional Requirements for Bibliographic Records, and the other is based on a model proposed by Professor Shoichi Taniguchi, entitled "the expression-prioritized model". The two models' abilities to handle documents that consist of different types of component parts are discussed. The bibliographic data from the discussed documents are filled into the databases and the physical consequences are discussed. The results show that the expression-prioritized model might be an improvement of the FRBR model. It gives a smaller database with less redundancy, yet it can reflect the same aspects of a document as the FRBR model.

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1.	Introduction.....	7
2.	Objectives, theory and methodology .....	8
2.1.	Objectives of the master thesis.....	8
2.2.	Theory and Methodology.....	8
3.	Structure of the master thesis.....	10
4.	The conceptual models.....	11
4.1.	The FRBR model .....	11
4.1.1.	Aggregate and Component Entities .....	15
4.1.2.	Reception of the FRBR model .....	17
4.1.3.	Problems with the FRBR model .....	18
4.2.	The expression-prioritized model .....	19
4.3.	Summarization .....	22
5.	Logical and physical models.....	24
5.1.	Logical models.....	24
5.1.1.	Building and designing the FRBR model .....	24
5.1.2.	Building and designing the expression-prioritized model .....	33
5.2.	The physical models.....	37
6.	Data foundation for comparison .....	39
6.1.	Data collection .....	39
7.	Comparison of FRBR and the expression-prioritized model.....	41
7.1.	The modelling of different types of documents .....	42
7.2.	Summarization of comparison .....	56
8.	Conclusions and further work.....	57
8.1.	Conclusions.....	57
8.2.	Further work.....	57
9.	References.....	59
10.	Appendix.....	61
10.1.	Appendix A: Single or multi-valued attributes in FRBR.....	61
10.2.	Appendix B: Alphabetical list of tables and attributes. ....	65
10.3.	Appendix C: Entities that are merged in the global view. ....	67
10.4.	Appendix D: Data dictionaries for the two logical models.....	70

# I. Introduction

The world of cataloguing never stands still, fortunately. A lot has happened the last forty years since the *Paris Principles* of 1961. The environment within which cataloguing principles and standards operate has changed dramatically. Automated systems for the creation and processing of bibliographic data are no longer a novelty. There has been an enormous growth of large-scale databases due to shared cataloguing programs and the continued growth of publishing output. At the same time there is a huge need to reduce cataloguing costs, e.g. by minimizing duplicate cataloguing effort and by using minimal level cataloguing. The users' expectations and needs are higher and more complex than ever. The demands to the cataloguing systems are different now, and the technological development has given us means to handle these demands in new and increasingly better ways.

Many of the cataloguing systems used in the majority of the libraries today still reflect the old card catalogue. They do not exploit the possibilities of the digitalization of data. In these cataloguing systems, as in the card catalogue, a bibliographic record lives in a relatively closed environment and there is no way of expressing many of the aspects and relationships of a document that we know exist.

The development of a conceptual model that meets the new demands, and is adapted to the digital reality and the World Wide Web, were therefore greeted with enthusiasm (for the most part) and were long anticipated.

The FRBR (Functional Requirements for Bibliographic Records) model saw its beginning at the 1990 Stockholm Seminar on Bibliographic Records. After many years of work and several rounds of hearing, worldwide reviews and comments from individuals and organizations, the report was finally presented to the Standing Committee of the IFLA Section on Cataloguing in 1997, at the 63<sup>rd</sup> General Conference of the International Federation of Library Associations and Institutions held in Copenhagen. The Standing Committee approved the final report at its meeting on September 5, 1997. The principles of cataloguing are reworked, and the foundation for a new generation of library systems is laid. The FRBR model is certainly not the only conceptual model that strives to rework the principles of cataloguing, but it is already widely known on several continents.

The process of changing the current cataloguing practice with millions of records worldwide is not easy. It is not a process that will take five years, or even ten years, but we finally see some proof that the process has started and that FRBR is one of the cornerstones in this change.

The FRBR model is the framework of this master thesis. It has been widely discussed on a conceptual level. With this thesis I hope to contribute to that discussion, and at the same time give an attempt to bring the discussion to a physical and practical level.

## 2. Objectives, theory and methodology

### 2.1 Objectives of the master thesis

In “*Functional requirements for bibliographic records: Final report*” (IFLA 1998), a structured framework for relating the data that are recorded in bibliographic records to needs of the users is described. Professor Shoichi Taniguchi, at the University of Tsukuba, has proposed a modified conceptual model based on this framework. Both these two models are on a conceptual level, i.e. they are entirely independent of all physical considerations.

On the basis of these two models, two primary objectives have been elaborated for this master thesis.

The first objective is to present two logical and physical databases based on these models. With this I hope to give some viewpoints on how it might be possible to model a database based on FRBR. It is an attempt to bring the discussion of the model from a conceptual to a practical level. It is also an exercise for my own interest in building a relational database.

The second objective is to compare the two databases’ ability to handle complex documents. A discussion on the conceptual level on how certain aspects of a document can be represented within the two models is given. Then the databases are filled with the data from these documents. With this I hope to visualize some of the physical consequences of the two models. Hopefully, this will indicate whether any of the two models are better in reflecting the aspects of different types of complex documents.

It is not always necessary to record all the aspects of a document in the bibliographic description, but when we wish to describe all aspects it is important that our database gives us that possibility. Therefore the user of the database is assumed to be of the most specialised type, interested in high detailed descriptions.

### 2.2 Theory and Methodology

The two models presented in this thesis are based on document analysis of “*Functional requirements for bibliographic records: Final report*” (IFLA 1998), “*A conceptual model giving primacy to expression-level bibliographic entity in cataloging*” (Taniguchi 2002), “*A conceptual model giving primacy to text-level bibliographic entity in cataloging*” (Taniguchi 2003a) and “*Conceptual modeling of component parts of bibliographic resources in cataloging*” (Taniguchi 2003b).

The data models are built with Enhanced Entity-Relationship modelling (EER, but for simplicity it will be referred to as simply ER). The diagrammatical representations of the ER models are based on the Unified Modelling Language (UML). Entity types are shown as rectangles labelled with the name of the entity. The first letter in the entity name is upper case. If the entity is written in lower case it would mean an instance of that entity. For example, “a work is expressed in one or more expressions” would mean “an instance of the entity *Work* is expressed in one or more instances of the entity *Expression*”.

Relationship types are shown as a line connecting the associated entity types, labelled with the name of the relationship (normally a verb or a short verb phrase). A relationship is only labelled

in one direction. An arrow symbol is placed beside the name indicating the correct direction for a reader to interpret the relationship name. Sometimes, modifications are made to enhance the readability of the figures.

The attributes of an entity are displayed with the first letter in lower case. When an entity and its attributes are presented in the text, the entity name is followed by a parenthesis containing the attributes. The primary key attributes are underlined. For example, *Form* (*formID*, *form*) indicates that the name of the entity is “Form”, and it contains the attributes “formID”, which is the primary key, and “form”.

The cardinality is represented with both minimum- and maximum cardinality beside the entities (e.g. 1..1 means that both the minimum- and maximum cardinality is one and the notation 0..\* means that minimum cardinality is zero and maximum is indefinite).

The process of normalization is used as a validation technique for the logical models. This technique is based on functional dependencies. This is explained more thoroughly in the text. A normalized database is less vulnerable to problems that might appear when it is updated.

Access is selected as database management system for the design of the physical databases. Structured Query Language (SQL) is used to communicate with the database.

In chapter 7 the ER-schemas are used as an analytic tool to discuss the modelling of different aspects of a document.

### 3. STRUCTURE OF THE MASTER THESIS

This master thesis contains eight chapters and an appendix:

Chapter 1:

A short introduction to the framework of this master thesis is given.

Chapter 2:

The objectives and the theoretical and methodological foundations of the master thesis are explained.

Chapter 4:

A presentation of the two conceptual models is given. The presentation is based on document analysis of “*Functional requirements for bibliographic records: Final report*” (IFLA 1998), “*A conceptual model giving primacy to expression-level bibliographic entity in cataloging*” (Taniguchi 2002), “*A conceptual model giving primacy to text-level bibliographic entity in cataloging*” (Taniguchi 2003a) and “*Conceptual modeling of component parts of bibliographic resources in cataloging*” (Taniguchi 2003b). The reception of FRBR is commented, and some problems with the model are pointed out. The chapter concludes with a summarization of the differences between the two models.

Chapter 5:

The main steps in the transformation from a conceptual to a logical and physical model are described. The differences between the two models are shown. The logical and physical models are further explained in the appendix section.

Chapter 6:

The data foundation for the building of the databases, the identification of different aspects of a document, and the testing of the physical databases is presented.

Chapter 7:

A discussion on how different aspects of a document can be modelled is carried out. Data is recorded in the databases and some physical aspects are pointed out. The two models are compared both on a conceptual and a physical level.

Chapter 8:

The main conclusions of this study and areas for further work are presented.

Appendix:

The appendix section contains supplementary information to the running text.

## 4. THE CONCEPTUAL MODELS

An interpretation of the two conceptual models is presented. Some of the problems people have encountered when dealing with the FRBR model are presented. The chapter concludes with a summarization of the differences between FRBR and the expression-prioritized model.

### 4.1 The FRBR model

The methodology used to develop the conceptual model of FRBR is based on entity-relationship analysis (ER-analysis). I will use the terminology from this methodology throughout this paper. In this chapter I will shortly show how the conceptual model is built. I will first cite the definitions of the entities of the model and give some comments on the cardinality issues and the relationships between the entities. I will present my interpretation of the FRBR model and give some arguments for why I have interpreted it this way.

The FRBR model consists of several entities divided into three main groups. Group One comprises the entities *Work*, *Expression*, *Manifestation*, and *Item*. These entities represent the product of intellectual or artistic effort that is described in bibliographic records. *Work* is defined as “a distinct intellectual or artistic creation” (IFLA 1998, p. 16). *Work* is wholly an abstract notion. As a cause of this abstract character it is difficult to find an operational definition of the entity. For example, an adaptation for children of a work might be viewed as a new work by some since it involves independent *intellectual or artistic* effort. Others will interpret it as a new expression of the same work. I will return to this problem in chapter 4.1.3.

The *Work* entity has a clear grouping capability (e.g. different translations of a work would easily be grouped by their relationship to this work (i.e. is a realization of)). This is in accordance with the conclusions drawn in “The FRBRization of Humphry Clinker” (OCLC 2002) which is a project at the Online Computer Library Center (OCLC) that aimed to examine the conversion of bibliographic records to conform to FRBR requirements. One of the conclusions of this project is:

“The FRBR notion of work is a valuable concept. It provides a means to aggregate bibliographic units to simplify database organization and retrieval” (ibid., Conclusions).

*Expression* is defined as “the intellectual or artistic realization of a work in the form of alphanumeric, musical, or choreographic notation, sound, image, object, movement, etc., or any combination of such forms” (FRBR 1998, p. 18). This entity contains attributes to describe the intellectual content, e.g. the specific words, paragraphs or notes of a document, and is not a physical entity. One of the main purposes of this entity is to indicate that the intellectual content in documents that physically differs from each other is the same.

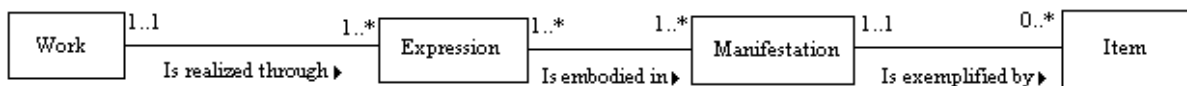
*Manifestation* is defined as “the physical embodiment of an expression of a work” (ibid., p. 20). This entity is, if we look at its definition, stated to be a physical entity, but if we look closer at its attributes, we will see that some of them (titles and responsibility designations) describe the intellectual content, which belongs to the expression level. Normally it is not the physical embodiment (i.e. the manifestation) that has been given a name, but the intellectual content, the text, which has been given a name. However, sometimes it might be argued that a title

statement has been given to the manifestation, for example, if the title statement is “Volume 3”, and refers to the third volume of the manifestation. The manifestation is therefore both a physical, and a non-physical entity.

All the three entities mentioned above are abstractions, and therefore represent general aspects of a document. They do not relate to any specific copy.

The last entity of group One is Item. It is defined as “a single exemplar of a manifestation” (ibid., p. 23). This entity would contain mostly local data (e.g. location of a document, missing pages, if the document is personally signed by the author, etc.).

**Figure 0.1 Group One entities and primary relationships**



I will now proceed with a discussion on the cardinality. Figure 4.1 is a schematic representation of the group One entities, their relationships and cardinality. The title, responsibility, and edition statements that appear in an item are all associated with the manifestation. These attributes play a significant role in the execution of the user tasks find, identify, and select works/expressions/manifestations. It is therefore reason to believe that the entity containing these attributes forms the basis for the bibliographic record, i.e. the entity given primacy. An instance of the entity given primacy must always be created. The minimum cardinality of Manifestation will therefore be one. This is not unproblematic. In some cases when modelling parts of a document that describe the intellectual content of the part (content parts) it seems difficult to create a manifestation record for the component part. This might indicate that one would need an alternative policy on the minimum cardinality for Manifestation for component parts. This will be discussed more thoroughly in chapter 7 where I will give examples on the modelling of different types of documents. The minimum cardinality of Manifestation will in this chapter be noted as one.

We want to be able to create a Manifestation record without necessarily having to create an Item record (e.g. in the acquisition module of a library system). A manifestation may therefore be exemplified by zero or more items. This is noted as 0..\* at the top left corner of the Item entity (the zero represents minimum cardinality, and the asterisk, \*, the maximum, which in this case is “many”).

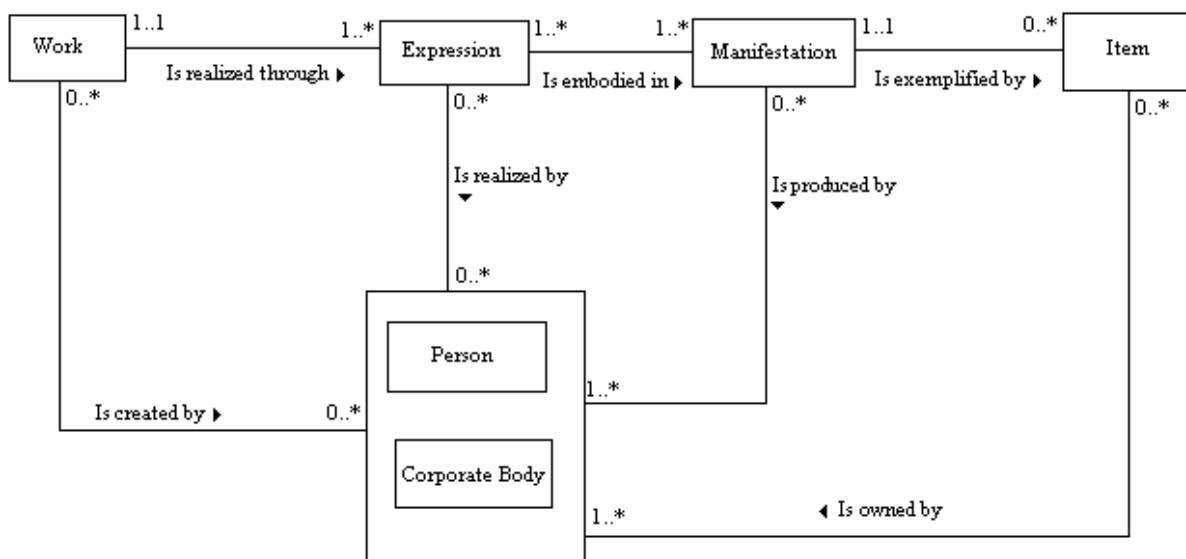
The “Is exemplified by” relationship is represented by a plain line drawn between the entities. In the figure it is read from left to right (as the arrow symbol indicates). The opposite relationship between Manifestation and Item (from right to left) would be read “Is an exemplification of”.

An item may exemplify one and only one manifestation (this is noted as 1..1 at the top right corner of Manifestation).

A manifestation may embody one or more expressions (1..\* at the top right corner of Expression), and an expression may be embodied in one or more manifestations (1..\* at the top left corner of Manifestation).

An expression is the realization of one and only one work. The cardinality on the Work side of the relationship is therefore 1..1 (top right side of Work). And finally, a work may be realized through one or more expressions (1..\* at the top left corner of Expression).

Figure 0.2 Group Two entities and relationships



Group Two comprises the entities *Person* and *Corporate Body*. *Person* is defined as “an individual” (IFLA 1998, p. 23), and *Corporate Body* is defined as “an organization or group of individuals and/or organizations acting as a unit” (ibid., p. 24). These entities represent those responsible for the intellectual or artistic content, the physical production and dissemination, or the custodianship of the entities in the first group. These two entities enable us to name and identify a person or a corporate body in a consistent manner, independently of how they are named in any particular expression of a work.

Figure 4.2 depicts the group Two entities and their relationships to the group One entities. The cardinality and relationships are read the same way as in figure 4.1. The cardinality between group One and group Two entities are many-to-many.

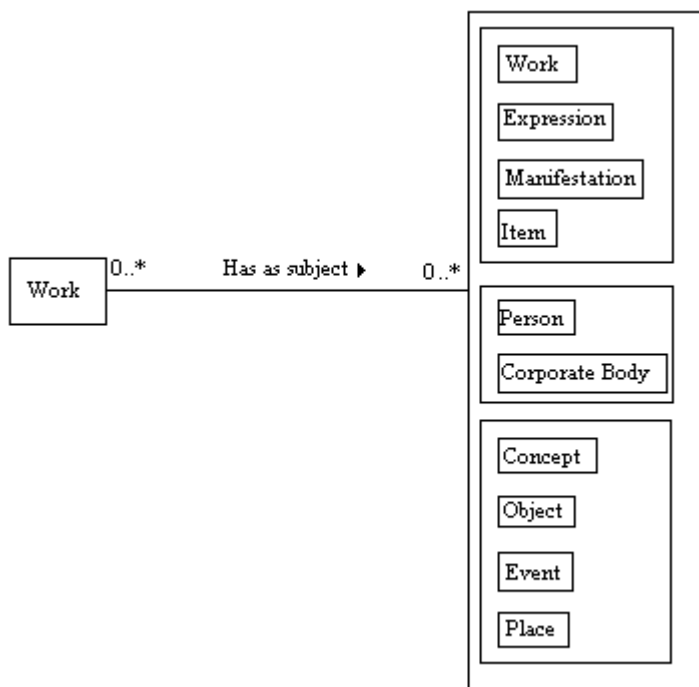
A work may be created by zero or more persons/corporate bodies. The cardinality is noted as 0..\* in the figure (at the right end of the “Is created by” relationship line). Minimum cardinality is zero because sometimes we will not be able to identify the creator of the work (e.g. the Bible, or traditional songs).

A person or a corporate body may create zero or more works (cardinality 0..\* at the left side of the “Is created by” relationship line).

Sometimes the ones responsible for the realization of an expression are unknown. For example, it is not always noted who the translator of a work is. If minimum cardinality is set to one, and not zero, it would imply that some data would have to be recorded, for instance “unknown”. This would cause problems if one would like to develop an authority register file using the Person and Corporate Body entities. An expression may therefore be realized by zero or more persons/corporate bodies (0..\*). A person/corporate body may realize zero, one or more expressions (0..\*).

A manifestation may be produced by one or more than one person/corporate body (1..\*), and a person/corporate body may produce zero or more manifestations (0..\*). An item may be owned by one or more than one person/corporate body (1..\*), and a person/corporate body may own zero or more items. This implies that data will be recorded in the database even if the ones responsible for the manifestation or the item is unknown (e.g. [s.n.]).

Figure 0.3 Group Three entities and relationships



The third group comprises the entities *Concept*, *Object*, *Event* and *Place*. *Concept* is defined as “an abstract notion or idea” (IFLA 1998, p. 25), *Object* is defined as “a material thing” (ibid., p. 26), *Event* is defined as “an action or occurrence” (ibid., p. 27), and *Place* is defined as “a location” (ibid.).

The group Three entities serve as subject of work. In addition to the four entities of group Three, the entities of group One and Two may also be treated as subject of a work. Figure 4.3 shows the relationship and cardinality between the entity *Work* and the group Three entities. The cardinality is many to many. A work may have zero or more subjects (0..\* at the right side of the “Has a subject” relationship line), and the subject entities may be the subject of zero or more works (0..\* at the left side).

#### 4.1.1 Aggregate and Component Entities

In the previous chapter we treated the group One entities as integral units, but often we will have aggregate and component entities. An aggregation is entirely conceptual and does nothing more than distinguish a “whole” from a “part”. An aggregation represents a “has a/part of” relationship between the entity that represents the whole, and the entity/entities that represent(s) the part(s). These relationships are linear (not hierarchical as the relationships within the integral unit).

On the *Work* and *Expression* levels these whole/part relationships are divided into two main categories: dependent- and independent parts. Dependent component parts are intended to be used in the context of a larger whole. These components depend on the references to the larger whole to be identified. Normally they do not have distinctive titles. The dependent category can be divided further into two subcategories: segmental- and systemic parts. Segmental parts are distinct identifiable segments within a whole (e.g. included prefaces). Systemic parts are integral aspects that are interwoven with the rest of the content (e.g. the sound aspect of a film). These relationships can be expressed less formally as a contents note. Independent parts often have distinctive titles and are not dependent on the context of a larger whole for their meaning (e.g. monographs in a monograph series).

On the *Manifestation* and *Item* levels (representing physical content) the component parts are divided in much the same way as on the *Work* and *Expression* levels. We have discrete physical units (corresponding to segmental parts, e.g. on the *Manifestation* level: vol. one of a ten-volume set of Ibsen’s collected works, and on the *Item* level: the two parts of a copy of this collected works vol. one, which in this particular case was separated into two parts), and integral parts (corresponding to systemic parts, e.g. on the *Manifestation* level: the soundtrack of a film that is embedded in the film, and on the *Item* level: a record jacket).



#### 4.1.2 Reception of the FRBR model

Does FRBR have a future? Are librarians and information specialists interested in this new (it still is) framework. The answer is without a doubt yes. The fact that FRBR is having an impact on standards like AACR2 and MARC 21 is a solid proof in that direction. Also, the response on the FRBR mailing list ([frbr@infoserv.inist.fr](mailto:frbr@infoserv.inist.fr)) and in professional literature reveals a great interest. It shows that the model is important and that it must be the foundation for the database of the future when it comes to storing and exchanging bibliographic records. In “*FRBR and further*” (Le Bœuf 2001), Patrick Le Bœuf has gathered comments on FRBR as found in professional literature on the Web. His paper gives examples of the response in Europe, Australia and in the USA. He found that there is an obvious interest in FRBR though it varies from country to country. It seems that the enthusiasm for the model is warmest in countries with a western culture. This might be an indication on the model not being as independent from culture and language as the original intentions were. Le Bœuf himself is very optimistic of the role FRBR will play. He states:

“In the future, library catalogues will predictably be conceived as web sites from the very beginning, not as just ‘ordinary’ databases eventually put on the web, as is the case nowadays, and FRBR will play an important role in this evolution” (Le Bœuf 2001, p. 44).

The OCLC project “*Experiments with the IFLA Functional Requirements for Bibliographic Records (FRBR)*” (Hickey 2002) states:

“The IFLA report [...] is having a profound impact on how people look at bibliographic data [...]. It seems clear that, at a minimum, anyone interested in the relationships between bibliographic items needs to take FRBR into account”.

Several countries have taken FRBR in use in formal training. This implies that more and more young librarians will be acquainted in the years to come with FRBR. This might be indications of FRBR playing a crucial role in future revisions of ISBDs.

Le Bœuf also presents proposals, found in professional literature, made to enhance the FRBR model, something I will return to in chapter 4.1.3, problems with the FRBR model.

In several projects, databases based on FRBR have already been developed. Two of the most known are the Australian Literature Gateway (AustLit, <http://www.austlit.edu.au>), and VisualCat in Denmark.

The European library automation group (ELAG) has, according to the document “*FRBR: Some comments by ELAG*” (Peruginelli 2000), performed several analysis on FRBR. This organisation is also very optimistic on behalf of FRBR. They claim that “[FRBR’s] design is not only of a high theoretical value, but also a practical one” (ibid., paragraph 1). They believe that the model will lead to a greater precision in retrieval of documents and an enhanced understanding of relationships between bibliographic elements. They also find that in a long term perspective the model will economize cataloguing efforts by reducing duplicate efforts. ELAG further expresses the need for “[...] experimental implementation in the real world of library systems, evaluating benefits and shortcomings” (ibid.). This paper is an attempt in this direction.

Aalberg (2000) discusses some practical approaches to FRBR. He emphasizes the ability to navigate in the “bibliographical universe”. Many times when searching in a bibliographic database

that contains collections from several institutions we will get the same document several times in our result set (duplicates). By dividing the bibliographic record in several levels we now have the means of grouping information elements that are identical which should help us avoid duplicates. The relationships between the levels will give the user possibilities to navigate in the hit list. Aalberg also points out that with the four levelled structure of FRBR it will be more difficult to create interfaces that are understandable for the users.

### 4.1.3 Problems with the FRBR model

Even though the reception of FRBR is mostly positive, several problems with the model have been pointed out. In this chapter I will present some of the problems that I hope this paper might be able to shed some light on. It seems the entity that poses the most problems is the Expression.

Many of the problems are of definitional art: how do we define a work, and how do we define an expression? How much can an expression be altered before we have a new expression (i.e. what do we consider to be minor corrections)? The definitions in the FRBR report are not good enough to resolve these issues. This paper does not attempt to solve these issues, but they will be touched upon in relation to other problems.

ELAG (Peruginelli 2000) found that it is highly problematic to assign some relationships between expressions (without specifying what sort of problems they have encountered). This type of problems will be discussed in this paper, and I will show that most of these relationships can be dealt with within the FRBR model, either hierarchically through the Work level or through whole/part relationships.

The Associazione Italiana Biblioteche (AIB 1999) would like to organize the Expression entity into a hierarchy. They use musical works as an example. A musical score and the performance of that score are two expressions at the same level of a common work. AIB argues that the performance should not be linked directly to the work, but should be linked through the score (on which it is based). This problem is related to the one mentioned above. The only way to model this relationship in FRBR is through a linear relationship (e.g. based on), but in reality the relationship between these two expressions are hierarchical (the performance is subordinate to the score on which it is based). AIB therefore propose to subdivide the Expression entity into four entities. Personally I believe that the relationships defined in FRBR are good enough to model these aspects of the Expression. A performance of a work is still a realization of this work even if it is based on another expression of the work.

In a mail on the FRBR Listserv Archive ([frbr@infoserv.inist.fr](mailto:frbr@infoserv.inist.fr), posted 2003.08.11) Martha Yee suggested that the attributes edition, title and statement of responsibility belong to the Expression, not the Manifestation, as suggested in the FRBR report. She argues that changes of value in these attributes are more likely to identify a change in the Expression than a change in Manifestation. She further claims that the attributes of the Expression are insufficient to identify all significant changes in intellectual and artistic content. This is in line with the model proposed by Taniguchi. This will be discussed later in this paper.

Taniguchi (2003b) gives examples on the modelling of component parts in FRBR and in the expression-prioritized model. He concludes that a content part is modelled differently from a

document part and a host item in FRBR, and that this is a weakness in the model. In chapter 7 of my thesis, where I give examples on the modelling of these document types, a content part and a document part is modelled in the same way in FRBR, but some problems did occur. The discussion is carried out in chapter 7.

## 4.2 The expression-prioritized model

The expression-prioritized model is a conceptual data model for bibliographic records, proposed by Professor Shoichi Taniguchi at the Institute of Library and Information Science, University of Tsukuba, Japan. This model has a strong resemblance to the FRBR model, but has some crucial modifications that open for new perspectives. The expression-prioritized model is presented in “*A conceptual model giving primacy to expression-level bibliographic entity in cataloging*” (Taniguchi 2002). It is further developed and exemplified the following year (see Taniguchi 2003a). This model is an integration of the FRBR model and Taniguchi’s own three-layered model (first presented in 1990 in Japanese (Taniguchi 1990). He continued to develop this model, and the reworked model is presented in his 2003a article referred to above). The model differs from FRBR by

1. how the bibliographic entities are defined,
2. what entity is to be given primacy, and
3. what attributes to associate with the different bibliographic entities.

The entities of the expression-prioritized model are defined with a combination of two methods. Taniguchi refers to these methods as the “hierarchical way” and the “parallel way”. In the hierarchical way “an item in hand is understood to result from the stepwise instantiation process from an idea itself that is the most abstract to a physical item” (Taniguchi 2003a, p.7). In the parallel way the “entities are built to be resulted from the division of an item into components that are mutually exclusive” (ibid., p. 15). According to Taniguchi, the former method is the one used to define the FRBR model, and the latter method is used to define the three-layered model. To me it seems the parallel aspect is present in FRBR, since the bibliographic entities are seen as integral units reflecting a document. The two methods of defining bibliographic entities are combined to define the expression-prioritized model. I had some problems following the argumentation of how this combination is done in practice. For a more detailed description on how this is done I therefore suggest reading Taniguchi’s 2003a article referred to above. However, the result of the combination of these two methods is clear. In Taniguchi’s model the bibliographic entities are more rigorously divided than in FRBR, the entities being mutually exclusive. For example, the distinction between carrier and content (Manifestation and Expression) is clearer in the expression-prioritized model, where the Manifestation is solely a physical entity. In FRBR on the other hand, it is a hybrid of physical- and intellectual content, as we have seen earlier in this paper.

The expression-prioritized model incorporates all the entities defined in FRBR, but instead of focusing on the Manifestation layer, as FRBR and current cataloguing practice do, it focuses on, and gives primacy to, the Expression level<sup>1</sup>. It is the Expression that will be the foundation for a

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<sup>1</sup> In his article “A conceptual model giving primacy to text-level bibliographic entity in cataloging: A detailed discussion” (Taniguchi 2003a), Taniguchi proposes a different terminology for the bibliographic entities than the FRBR terminology: namely expression/text instead of expression, manifestation/medium for manifestation, and

bibliographic description, not the Manifestation. This is certainly the most important feature of Taniguchi's model. This is what makes it interesting for further investigation. However, the gap between what we have in front of us and what we want to describe is increased. Taniguchi writes:

“When we adopt a model that gives primacy to a text-level entity [see footnote 1], we must use a physical object in hand to arrive at a general text description [...] that will apply to all manifestations containing the identical text, in addition to a general physical description that will apply to all other instances of copy-level.” (Taniguchi 2003a, p. 41)

The gap between the object in hand to what we intend to describe (from the item in hand to the expression) is bigger than in current cataloguing practice where the gap is from item to manifestation. This increased gap might, as Taniguchi points out, lead to a need for revision and extra cataloguing efforts as related manifestations appear. This seems to be a potential drawback, but it is uncertain how severe it might be.

The expression-prioritized model is hierarchical in the way that the other bibliographic entities are subordinate to the Expression: Manifestation is subordinate to the Expression and Item is subordinate to the Manifestation. Work is defined as being intermediary to access Expression.

The attributes of the entities of the expression-prioritized model are for the most part identical to the FRBR model, but for two of the entities, namely the Expression and the Manifestation, there are some significant differences. Taniguchi changes the domain for the title of Expression attribute, adds two new attributes (responsibility and edition) to the Expression entity, and changes the domain for the corresponding attributes at the Manifestation level. He argues that label information such as titles, statements of responsibility, and edition designations that appear in an item is associated with the Expression and not the Manifestation. This label information describes aspects of the Expression (the content), rather than aspects of the Manifestation (the carrier). Excepted are label information related only to the physical embodiment of a text, which would belong to the Manifestation.

User tasks related to the entity given primacy are accomplished with the attributes of that entity. Taniguchi argues that the attributes mentioned above are necessary for the user tasks finding and identifying an expression, and therefore belongs to the Expression level. As we have seen earlier, the FRBR model does not specify any source for the title of the Expression. Taniguchi claims this can be taken from the document in hand. In current cataloguing practice we make a new record for a new text, but we also make a new record if we have the same text in a different format. We choose to communicate the difference in manifestation rather than the identity of the expression. This has been called the “format variations” or “multiple versions” issue. The expression-prioritized model gives an attempt to solve this issue.

What Taniguchi calls upward pseudo-assignment, is caused by the fact that the attribute *title of Expression* in FRBR has no substantial content. There is no ISBD or GARE data element mapped to the attribute. To support the user tasks find, identify and select Expression the data model must “inherit” attributes upward from Manifestation to Expression. The label information found on an item, which is the source for the Manifestation attributes *title* and *responsibility* will also be mapped to Expression. As a result we get a database with a lot of redundant data. We would

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item/copy for item. I will only use this terminology in direct quotes, unless otherwise noted I will use the FRBR terminology throughout.

want to avoid this redundancy. When moving titles and statement of responsibility found in the document to the Expression level we remove this redundancy.

Taniguchi opens for the possibility to assign subject terms to the Expression in stead of the Work as an alternative policy. This might be a consequence of choosing the policy of creating a work in limited cases as described below. However, it is not likely that expressions of the same work will have different subjects. The attribute therefore clearly belong to the Work level.

We now have all the bibliographic entities and their attributes. The entities and relationships of group Two and Three in FRBR are unaltered in Taniguchi's model, they will not be repeated here. I will continue with the discussion of the cardinality. Because the entities, defined both the hierarchical and the parallel way, are mutually exclusive we have no limitation on the number of entity instances in a relationship. The cardinality between the bibliographic entities in the expression-prioritized model is therefore many-to-many. This should not cause any problems, but it would imply that an Item may *compliment*<sup>2</sup> several instances of Manifestation. It is hard to imagine that this would occur in practical cataloguing. It seems more natural to have a one-to-many relationship between Manifestation and Item as is the case in FRBR. I will however let the many-to-many relationship between these entities stand since it has no practical consequences for my discussions because I have left out the Item level.

Let us now look at the minimum cardinality. Taniguchi writes:

“An instance of the entity which was given primacy must be created for every item”  
(Taniguchi 2003a, p. 46)

This implies that the minimum cardinality of Expression is one. This leads to a minimum cardinality of one also for the bibliographic entities below Expression (i.e. Manifestation and Item). This as a result of the model being defined both the parallel and hierarchical way. This implies that we need to create an instance of Item even if we do not have any data to fill in. The Item record would then only consist of an Item identifier, e.g. an “iID”. For example, this would be the case when handling acquisition or purchase of an item. The minimum cardinality of Item will be noted as one here, but in the discussions in the later chapters, the cardinality is actually zero since I have left out the Item entity.

The minimum cardinality of Work is either one or zero. Taniguchi operates with two different policies.

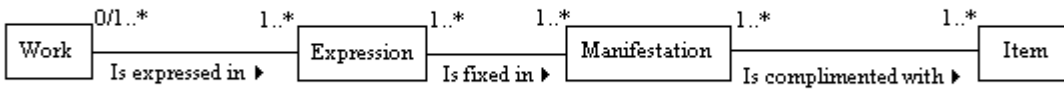
“If the minimum cardinality is zero, it means to create a work in limited cases. According to the current AACR, and thus, in modeling the current practice, for example, uniform title authority records apply to restricted cases or types of items, a work instance is created in restricted cases.” (Taniguchi 2003a, p. 20)

I will operate with the minimum cardinality of zero in this paper, since this gives an interesting contrast to FRBR. Figure 4.5 depicts a schematic presentation of the entities and relationships in the expression-prioritized model.

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<sup>2</sup> This is the terminology of the expression-prioritized model. See figure 4.5 for the terminology of the relationships.

**Figure 0.5 The expression-prioritized model**



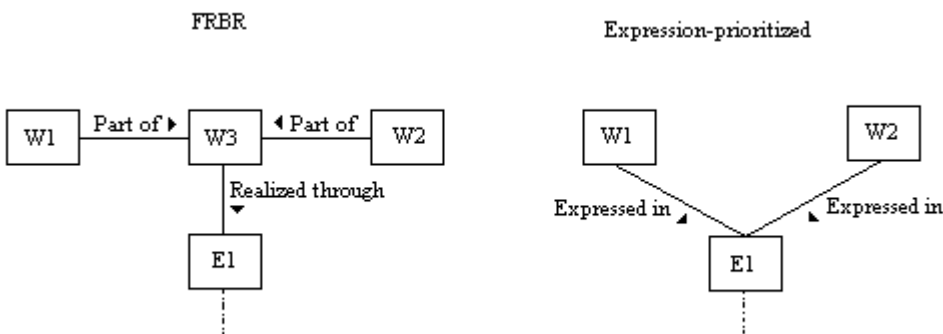
The many-to-many relationship between Work and Expression allows the creation of Work instances in a flexible manner. More than one instance of Work can be created against a single instance of Expression.

### 4.3 Summarization

This chapter sums up the important differences of FRBR and the expression-prioritized model.

In FRBR, an expression can only realize one work, whilst in the expression-prioritized model it can express several works. This opens for a new way of modelling the relationships between these entities. Figure 4.6 shows the two different approaches. Let us say that we have a document that comprises two independent works. In FRBR the relationships are modelled on the Work level as whole/part relationships, i.e. the work W1 is part of W3, W2 is part of W3, and W3 is realized in E1. In the expression-prioritized model the relationships are direct, i.e. W1 is expressed in E1, and W2 is expressed in E1.

**Figure 0.6 The same relationships in the two models**



Another significant difference is that the expression-prioritized model opens for a policy where a Work instance is only created in limited cases. Figure 4.6 illustrates this difference also. We see that in FRBR three works have been created (the third, W3 being a collection of the two other works), while in the expression-prioritized model it is not necessary to create this work.

A third difference is that in the expression-prioritized model, the attributes title, responsibility, and edition statements that appear in an item is associated with the Expression. In FRBR these attributes are associated with the Manifestation. In the expression-prioritized model the

Manifestation does not have any title statements, and only the responsibility and edition statements that are related to a difference in carrier are associated with this entity.

## 5. LOGICAL AND PHYSICAL MODELS

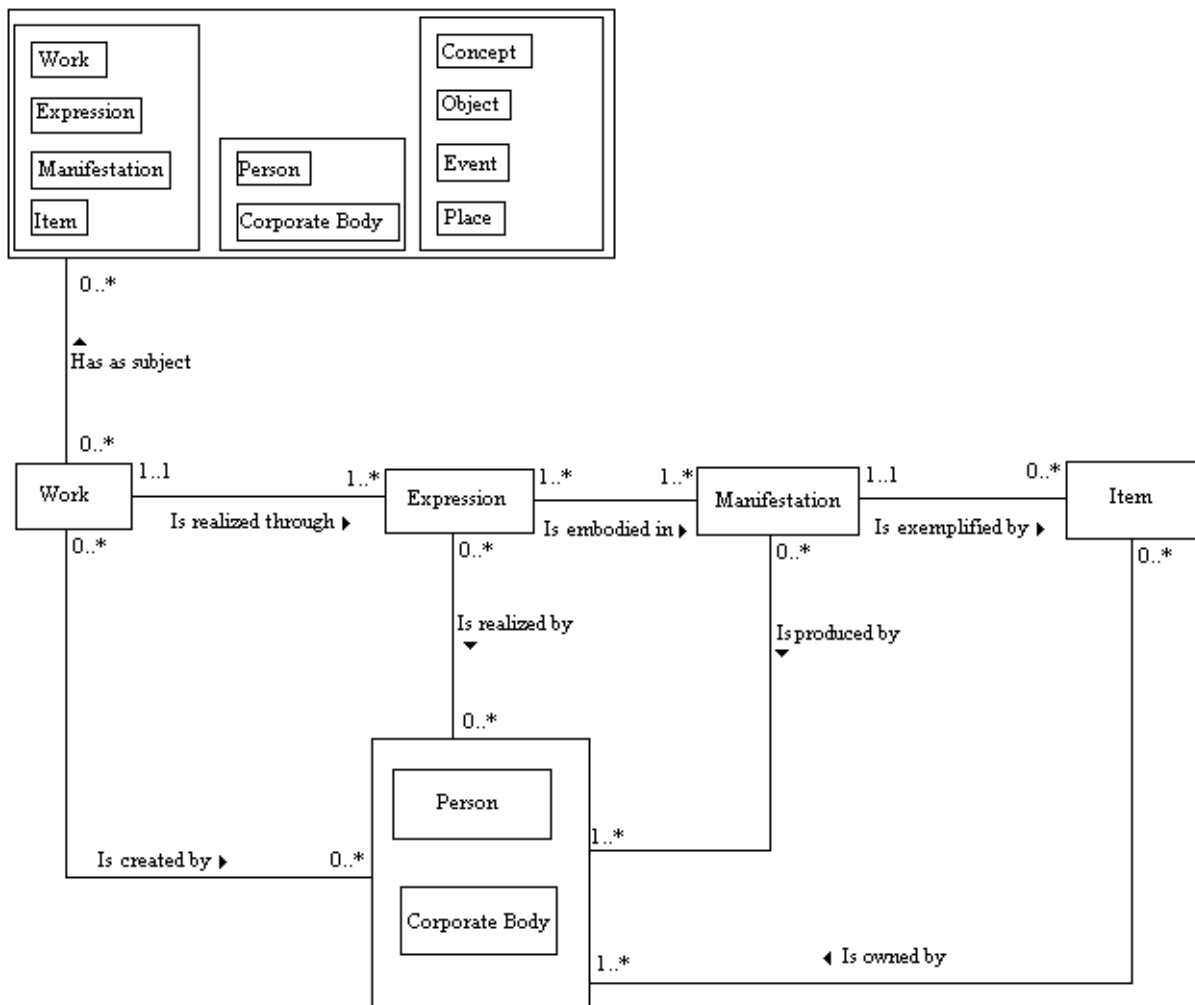
Conceptual data models will in most cases contain structures that are not easily modelled by conventional relational database management systems (DBMS), i.e. Access, as I have chosen to use. These structures must be transformed into a form that more easily can be handled by a DBMS. In this chapter I will describe shortly the most important steps in this transformation. The data collection described in chapter 6 was used to help plot out data elements that were not covered by the IFLA report (1998). The logical expression-prioritized model is built by performing alterations on the logical model. This chapter is therefore mainly devoted to the building of the FRBR database. Chapter 5.1.2 where the building of the logical expression-prioritized model is described only discusses the parts which are different from the FRBR model.

### 5.1 Logical models

#### 5.1.1 Building and designing the FRBR model

The logical database is independent of a particular DBMS and other physical considerations. The logical model consists of an ER-diagram, a relational schema, and supporting documentation. I will divide the conceptual FRBR model (shown in figure 5.1) into three different views corresponding to the bibliographic entities (the Item level is omitted here). Figure 5.1 shows our starting point for building a logical model. The whole/part relationship types are left out of figure 5.1 to make it less complex and easier to read. The relationship type between a “whole” and a “part” would be many-to-many (1..\*:0..\*, a *whole* may have zero or more *parts*, and a *part* may be part of one or more *wholes*).

Figure 0.1 FRBR: the global conceptual model



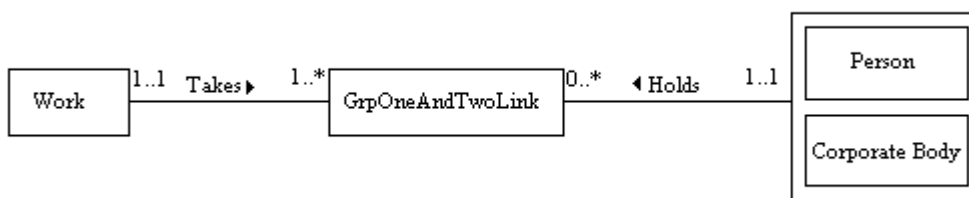
The first step is to remove many-to-many (\*:\*) relationship types. Looking at figure 5.1 we see that there are \*:\*) relationship types between all the entities, except between Work and Expression, and Manifestation and Item, where we have one-to-many (1:\*) relationship types. Table 5.1 enumerates the different \*:\*) relationship types in the FRBR model. The entity named *subject* comprises all of the entities of group One, Two and Three (i.e. Work, Expression, Manifestation, Item, Person, Corporate Body, Concept, Object, Event, and Place).

Table 5.0.1 Many-to-many relationship types in the FRBR model.

Entity	Relationship type	Related entity
Work	0..*:0..*	Corporate Body
Work	0..*:0..*	Person
Work	0..*:0..*	Subject
Expression	1..*:1..*	Manifestation
Expression	0..*:0..*	Corporate Body
Expression	0..*:0..*	Person
Manifestation	0..*:1..*	Corporate Body
Manifestation	0..*:1..*	Person
Item	0..*:1..*	Corporate Body
Item	0..*:1..*	Person

Removing a *0..\*:0..\** relationship can be done by decomposing this relationship to identify an *intermediate entity*. The *0..\*:0..\** relationship is replaced with two *1..\*:1..\** relationships to the newly identified entity. For example, the relationship “a work is created by one or more than one person/corporate body” can be decomposed into a new, weak entity (since no primary key has been identified, and its existence depends on the entities Work and Person/Corporate Body), and two new *1..\*:1..\** relationships. I will call the new entity *GrpOneAndTwoLink*, since this entity serves as a link between the entities of group One and group Two (only the relationship with Work is shown here since it is the Work view we are building), and the new relationships *Takes* and *Holds*. This is shown in figure 5.2. The other *0..\*:0..\** relationships are removed in the same manner (e.g. Subject, SubjectLink and Work). We see that we now have *1..\*:1..\** relationships between all the entities involved. An instance of the entity Work *Takes* one or more instances of the entity *GrpOneAndTwoLink*, and an instance of the entity Person/Corporate Body *Holds* zero or more *GrpOneAndTwoLink*.

Figure 0.2 Decomposing the ‘Is created by’ relationship



The next thing we need to do is go through the attributes and remove all multi-valued attributes<sup>3</sup>. A multi-valued attribute can be decomposed to identify a new entity. For example, the attribute title of work is multi-valued. It is clear that a work can have several titles. The FRBR final report states:

“There may be one or more titles associated with a work. If the work has appeared under varying titles (differing in form, language, etc.), a bibliographic agency normally selects one of those titles as the basis of a ‘uniform title’ for purposes of consistency in naming and referencing the work” (IFLA 1998, p.33).

We may therefore remove this multi-valued attribute and identify a new entity called *Title*. Now we can create an instance of the Title entity for every title that is associated with a work. The relationship between this new entity and the entity *Work* is many-to-many. It would therefore have to be decomposed in the same manner as I have described above in the comments to figure 5.2. We get two new entities out of this one attribute: *Title*, and *TitleLink*. According to the FRBR report, *Work* has 12 attributes. Appendix A lists all the attributes of the FRBR model and indicates if they are multi-valued or not. The attributes *intended termination*, *coordinates* and *equinox* are left out to make the model smaller and also because no cartographic work were found in the data collection (see chapter 6). The attribute *musical key* is also left out, but this information can be placed in the *OtherDistChar* table if necessary. We are then left with eight attributes, and six of them are multi-valued (see appendix A). New entities are derived from these multi-valued attributes.

The *Work* entity is then left with the two attributes *form of work* and *date of work*. None of these two attributes can serve as a primary key. A primary key must have a distinct value for each entity occurrence, and it cannot contain a null value. Both *form* and *date of work* may be empty (hold a null value), and neither of them are unique since several works may have the same form and date. A new attribute, called *wID* (short for Work ID), will therefore be assigned. The value of *wID* will be automatically assigned by the DBMS. The domain for the attribute date of work is a single date, or a range of dates (e.g. 1988-1990). The attribute might therefore be interpreted as a composite attribute. Two simple attributes would then be derived of this composite attribute. For the purpose of this master thesis I have chosen to simplify and leave it as one attribute named *wDate*.

It is often desirable to write comments (notes) to a work that do not correspond to any of the attributes we have. The attribute *otherInfo* will be assigned as a note field containing text. The attribute *typeOfWork* is also assigned to be able to distinguish series (which are defined as works), and other types of works. The attribute form of work will be called *form* in my data model. The entity *Work* will then consist of the following attributes (the primary key is underlined):

*Work* (wID, form, wDate, typeOfWork, otherInfo).

The entity *OtherDistChar* is a weak entity. The primary key of a weak entity is partially or fully derived from each owner entity. There is a 1:\* relationship between *Work* and *OtherDistChar* (see figure 5.3). A *Work* instance may take zero or many instances of *OtherDistChar*, and one instance of *OtherDistChar* is taken by one and only one instance of *Work*. The entity on the

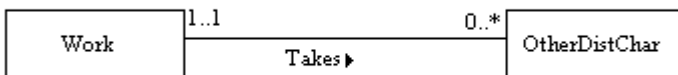
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<sup>3</sup> A multi-valued attribute holds several values for each instance of the entity.

“one side” of the relationship (Work) is designated as the parent entity. The entity on the “many side” is designated as the child entity.

The relationship between these two entities is established by posting a copy of the primary key of the parent entity into the child entity. This attribute will then be a foreign key in the child entity.

Figure 0.3



OtherDistChar now contains the attributes *wID* (foreign key from the parent entity Work), and *distChar*. A Work instance may take several instances of Other DistChar. The attribute *wID* can therefore not serve as a primary key for this entity. A new attribute, *charID*, is assigned. We now have the following attributes mapped to this entity:

OtherDistChar (*charID*, *wID*, *distChar*)

After a similar approach on all the entities in the model we validate the relations by using the technique of normalization. The objective here is to avoid unnecessary duplication of data and to make sure that the model is consistent. A normalized database is easier to update than an un-normalized database. However, it is not always the situation that a fully normalized database has maximum processing efficiency. Sometimes we will accept redundancy in the database if it enhances the ease-of-use.

I will use the entities Title and TitleLink as examples on how normalization is used to validate the data model. We have already stated that a work may have several titles. The attribute *title* is therefore not qualified as a candidate for the primary key. The attribute *titleID* is assigned as a primary key.

For an entity to be in the first normal form (1NF), each attribute of the entity needs to contain one and only one value. We know that a title may be complex. The main title is often supplemented with a subtitle. There are two ways of modelling this relation. One is to derive a new entity called *Subtitle*, and link this entity to the Title entity. The other way is to derive a new attribute, called *subtitle*. I have chosen the latter method. This might lead to some redundancy, since several titles may have the same subtitle, and identical titles may have different subtitles. In a small database such as my experiment base, this is not a big problem. I have therefore chosen this method since it gives me a simpler model with fewer entities.

For a relation to be in the second normal form (2NF), every non-primary-key attribute must be fully functionally dependent on the primary key. The values of the attributes *title* and *subtitle* are given when we have the value of *titleID*, but if given the value of *title*, we do not necessarily know

the *titleID*. There may in fact be several values of *titleID* since several identical titles might have different subtitles. The non-primary-key attributes are therefore functionally dependent on the primary key attribute. In this example where the primary key is a single attribute, we automatically know that this dependency is a fully functional dependency. If the primary key consisted of several attributes, the non-primary-key attributes must not be functionally dependent on any subset of the primary key. The primary key of the TitleLink entity consists of two attributes (underlined):

TitleLink (wID, titleID, typeOfTitle)

The *typeOfTitle* attribute helps us to distinguish main and part titles etc. The relations of TitleLink is in 2NF if, when removing any of the primary key attributes, the dependency of the non-primary-key attributes no longer is sustained. For example, if we remove *titleID* from the primary key, we will not know the type of title since a work may have several titles. TitleLink is therefore in 2NF.

For a relation to be in the third normal form (3NF), no non-primary-key attribute is transitively dependent on the primary key. For example, if the attribute *subtitle* is unequivocally given when we know the value of *title*, *subtitle* would be functionally dependent on *title*. Since *title* is functionally dependent on the primary key, *subtitle* would be transitively dependent on the primary key via *title*<sup>4</sup>.

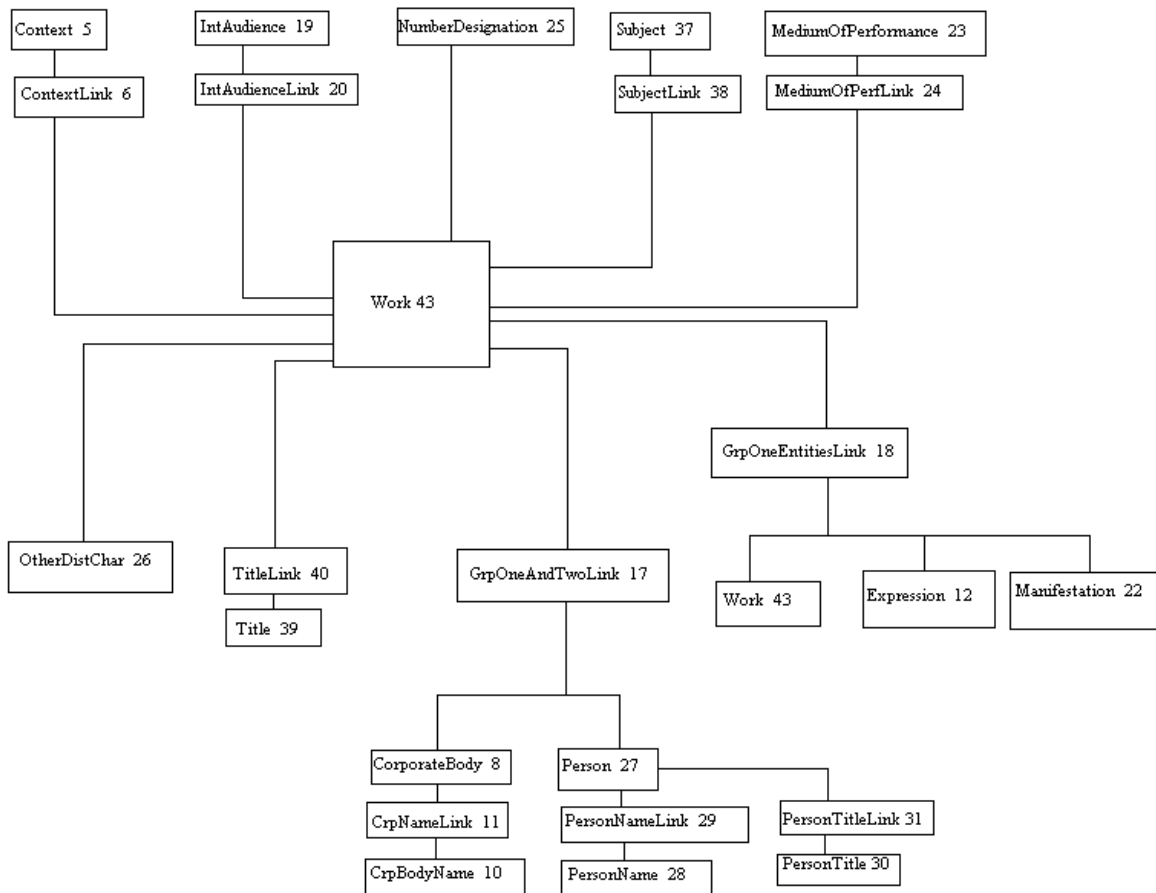
This is however not the case, because identical titles may have different subtitles (and vice versa) we do not have any functional dependencies within the non-primary key attribute, and thus neither any transitive dependencies. The relations are now in 3NF. There are several higher normal forms, but the normalization is not taken further here.

After normalizing the relations we should have a structurally consistent model which is logical and has minimal redundancy. Figure 5.4 show a schematic representation of the Work view. Every entity represents a table in the physical database. The numbers at the right of the entity name correspond to the number each table is given in the alphabetical list of entities (see appendix B).

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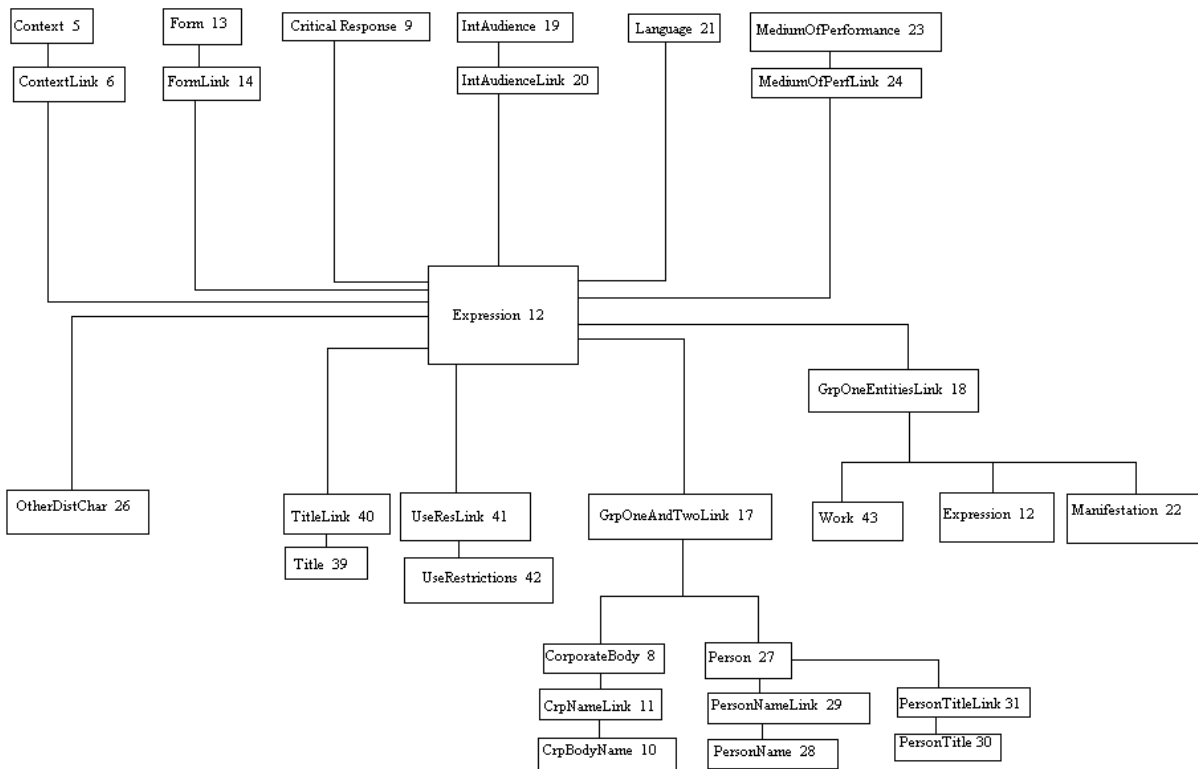
<sup>4</sup> Transitive dependency occurs if attribute A determines attribute B (denoted  $A \rightarrow B$ ), and attribute B determines attribute C ( $B \rightarrow C$ ). Attribute C would then be transitively dependent on A via B (if  $A \rightarrow B$  and  $B \rightarrow C$ , then  $A \rightarrow C$ ).

**Figure 0.4 Local logical data model for the Work view**

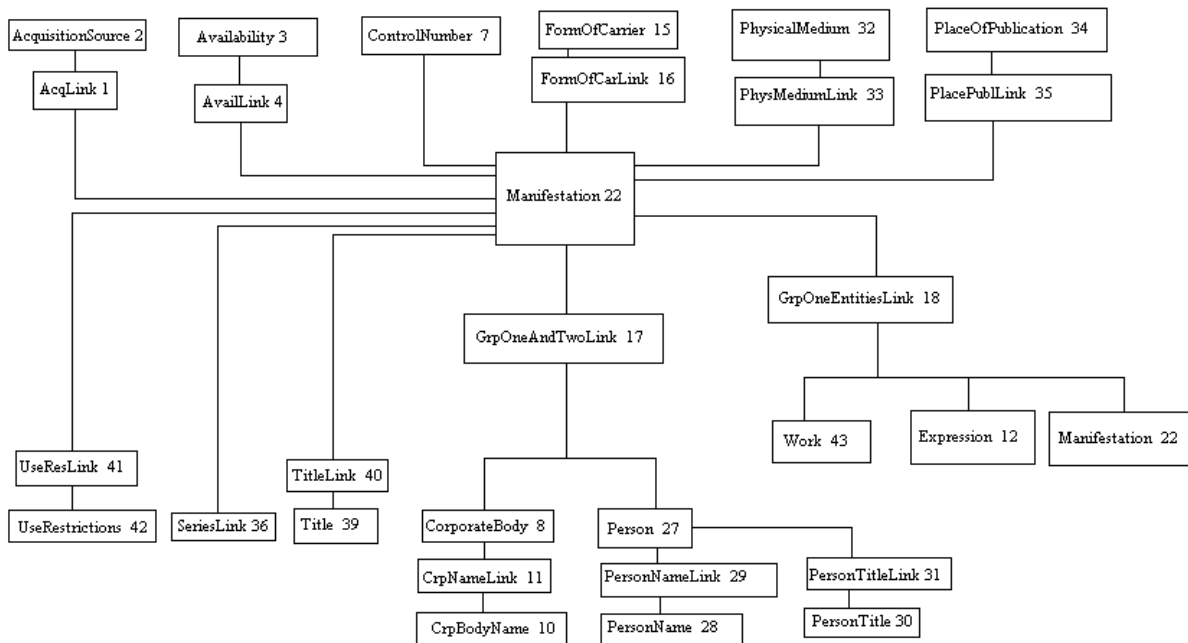


After building local logical models for the Expression and Manifestation views, the individual logical models are merged into a global model. The local models for Expression and Manifestation are shown in the figures 5.5 and 5.6. The table *SeriesLink* (table number 36) that we see in the Manifestation view (figure 5.6) is a link table that serve the same use as table 18, *GrpOneEntLink*. It links a “part manifestation” to a “host manifestation” when the host is a series. The reason for separating this from the *GrpOneEntLink*, which links whole/part relationships, is that we want to be able to assign a number designating the sequential position within the series.

**Figure 0.5 Local logical data model for the Expression view**



**Figure 0.6 Local logical data model for the Manifestation view**



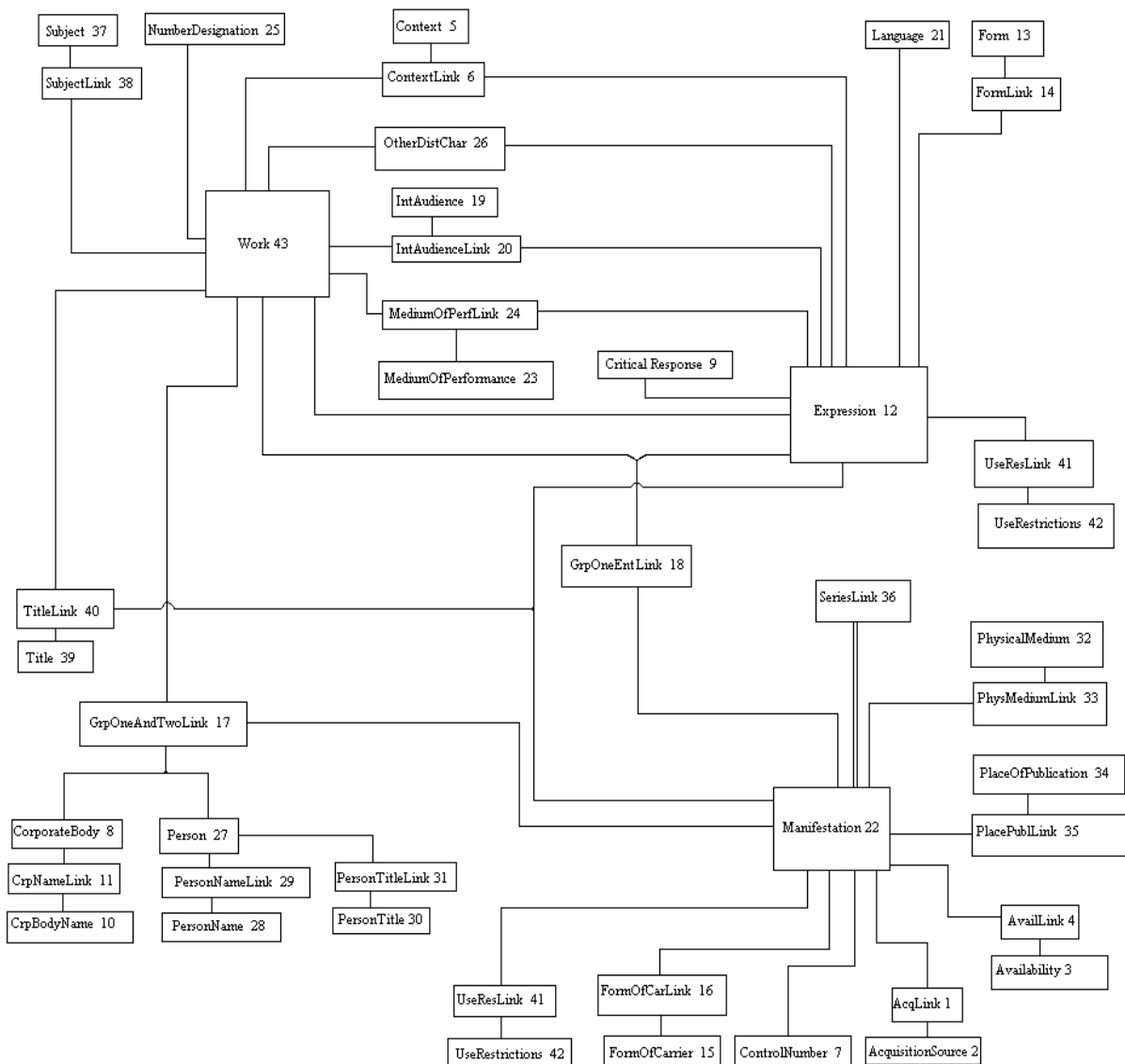
Looking at the three figures of the local models we see that several entities are identical in the different views. For example, we see that the entities *Title* and *TitleLink* exist in all the three views. In the FRBR model we have title statements on the Work level, on the Expression level and on the Manifestation level. If this data is stored in three different locations (i.e. tables) in our database we would get a lot of redundancy since the titles on the three levels often would be identical to each other. It would also cause unnecessary programming when creating a search module for the database, since one would have to check at least three different tables when performing a title search. A lower processing efficiency would also be a result of this. The Title entities will therefore be merged into one entity containing titles in general, corresponding to all the three bibliographic entities mentioned above. The two general attributes *ID* and *typeOfID* (with the domain W, E, M) will replace the specific attributes *wID*, *eID*, and *mID* of the entity *TitleLink*:

*TitleLink* (*ID*, *typeOfID*, *titleID*, *typeOfTitle*)

Relations that are changed during the merging process are again validated using normalization. Appendix C lists all the entities that are merged when building the global model.

After the normalization process and the merging of the local views into a global model we are left with 43 tables. Figure 5.7 shows the global relational diagram for the whole FRBR model.

**Figure 0.7 Global data model for FRBR**

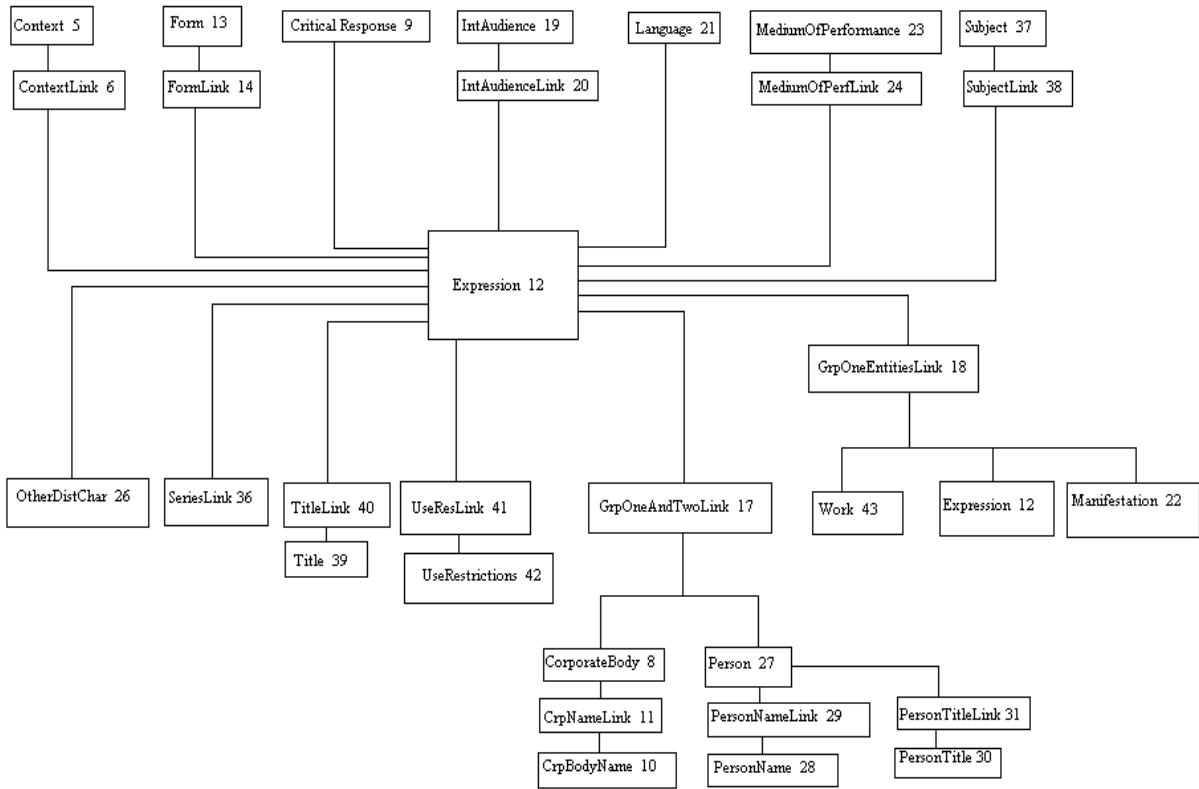


### 5.1.2 Building and designing the expression-prioritized model

The expression-prioritized model is built using the logical model of FRBR as a starting point. Most of the entities will not be affected when the model is transformed from FRBR to the expression-prioritized model. In this chapter I will describe the entities and relationships that differ.

In the expression-prioritized model the series designations found in a document is associated with the expression, not the manifestation as in FRBR. The expression view for the expression-prioritized model is shown in figure 5.8. We see that table 36, SeriesLink, now is associated with the Expression entity.

**Figure 0.8 Expression view for the expression-prioritized model**



**Figure 0.9 The Manifestation view of the expression-prioritized model**

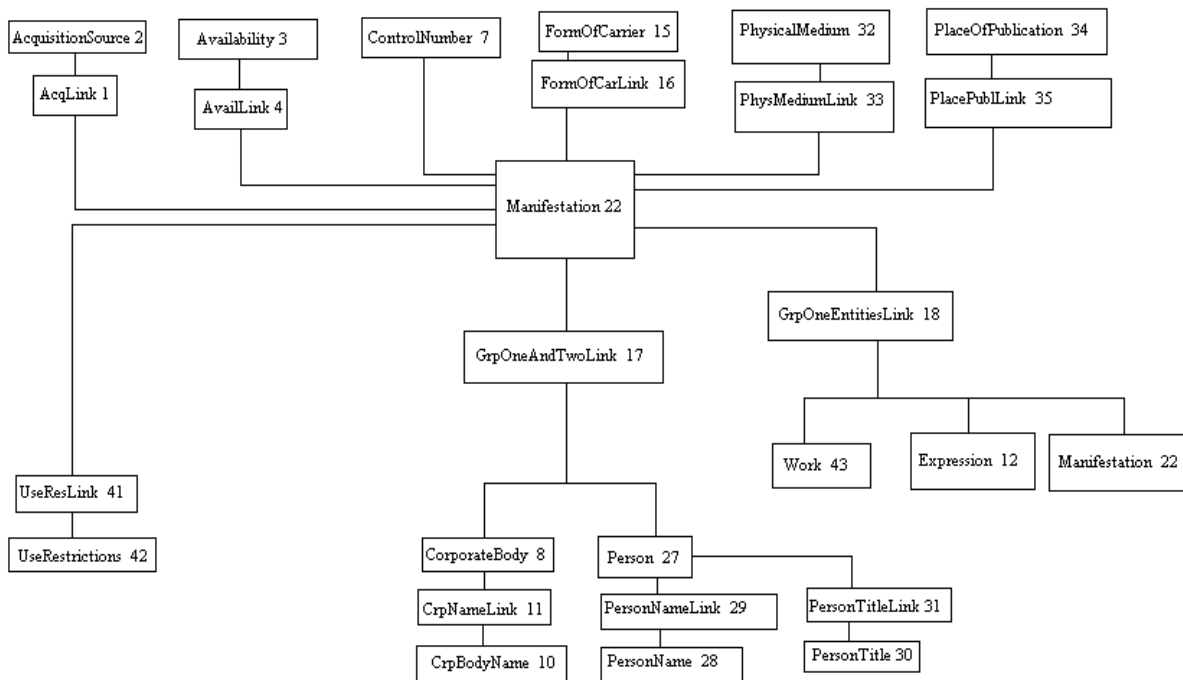
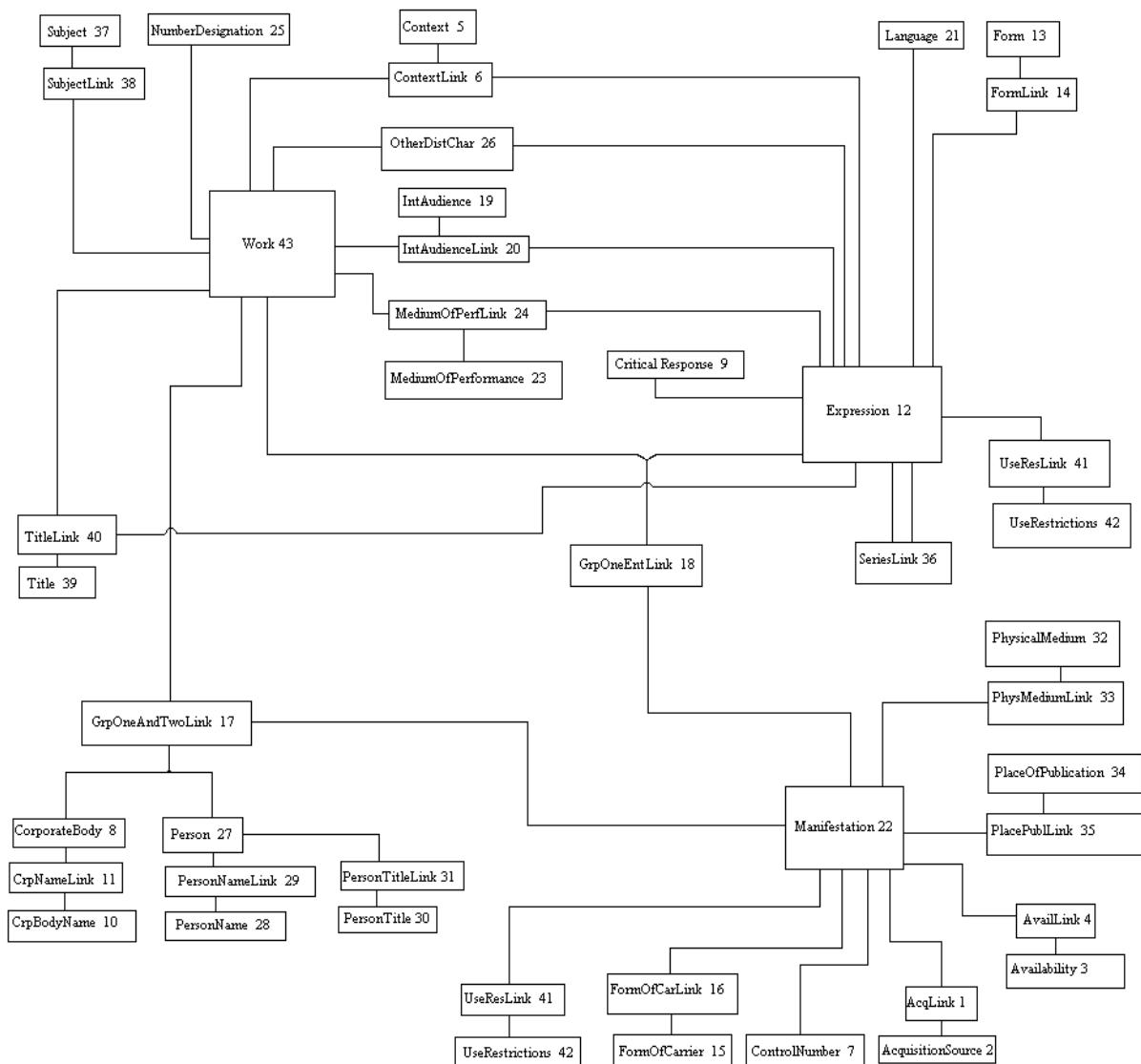


Figure 5.9 shows the Manifestation view. The Manifestation does not have any title statements, neither any series designation. The entities Title, TitleLink, and SeriesLink are therefore removed.

Figure 5.10 shows the global view for the expression-prioritized model. The relationship line between Work and Expression (symbolizing: *a work is realized through one or more expressions*) has been removed. All the relationships between Work and Expression is now implemented through GrpOneEntLink. The relationship line between TitleLink and Manifestation has been removed. The entity SeriesLink is now associated with the Expression. The data dictionaries for the two logical models can be found in appendix D.

Figure 0.10 Global view of the expression-prioritized model



Two of the attributes, *responsible* and *edition*, have the same names and belong to the same entity, Manifestation, in both FRBR and the expression-prioritized model, but they have different domains. In the expression-prioritized model the domain for the Manifestation attribute *responsible* is restricted to statements which are related to manifestation layer, i.e. the formatting of a text, typeface, page-layout, etc. The domain for the attribute *edition* is restricted to statements relating to difference in form of carrier. The domains of the different attributes are shown in appendix D.

## 5.2 The physical models

The starting point for the building of the physical databases is the logical data models. The entities, attributes, relationships, and constraints are “translated” into a physical database. The database is implemented with a DBMS. I have chosen Access as a DBMS since it is fairly good and easily accessible for most people being the standard equipment on most PCs.

Each entity in the logical model corresponds to a table in Access. Figure 5.11 shows the creation of the Expression table of the expression-prioritized model in the Design view of Access. The attributes will each be the header of a column (field) in the table. Each instance of an entity will form a row (record) in the table.

The data type and length of the attributes are determined. The primary keys for each table are created. The primary key in the Expression table consists of only one attribute, *eID*. The key symbol in front of *eID* indicates that we have chosen this attribute as primary key. Table properties like field size and validation rules are also implemented in this view. The figure shows the validation rule for the attribute *regularity* which can take two values: “r” or “i”.

We further have to create restraints like: can we allow a field to be empty? Is the field mandatory?

Figure 0.11 Excerpt from the Design View of Access

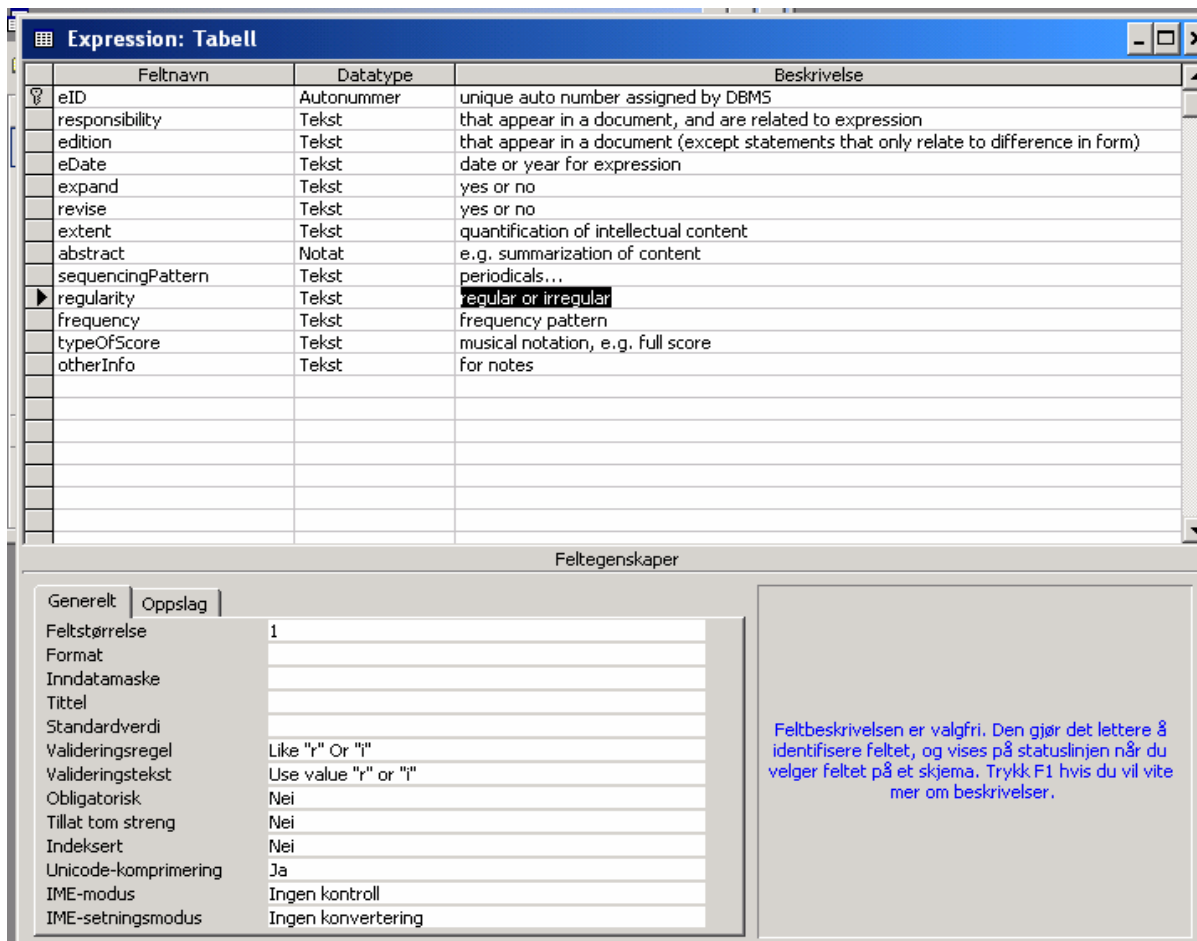
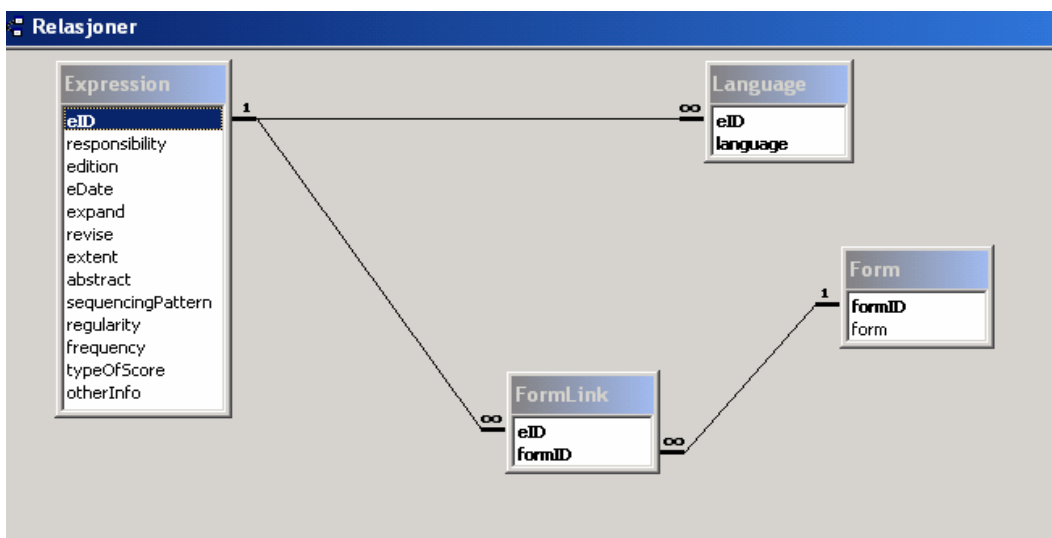


Figure 5.12 shows the Relationships view of Access. The creation of one-to-many relationships between *Expression* and *Language*, *Expression* and *FormLink*, and *FormLink* and *Form* is shown.

We then decide which attributes we want to be indexed. The primary keys are automatically indexed. Also the foreign keys are automatically indexed (we establish the foreign keys when we create relationships between the tables in the Relationships window). In addition we might want to index some other attributes with the data type *Number*, *Text* or *Date/Time* if we anticipate searching for values stored in the field, and many different values are stored in it.

Figure 0.12 Relationships window of Access



When all the relationships and constraints are implemented the database is ready to be filled with data.

## 6. DATA FOUNDATION FOR COMPARISON

### 6.1 Data collection

The data collection used as a foundation for this master thesis was collected by associate professor Liv Aasa Holm at the Library and information studies, Oslo University College, Norway. She had performed a search in SAMBOK, which is a database service at the National Library of Norway (URL: <http://www.nb.no/baser/sambok2/>).

The search criteria was “Gynt” (title search), and “Ibsen, Henrik” (person).

The hit list showed 354 hits. Many of them were duplicates, or different editions of the same work. The MARC records of these documents were used when building the logical models. They were used to find additional attributes to the ones presented in the FRBR report (IFLA 1998). They were analyzed to find the particular aspects of different types of documents (i.e. relationships within a complex document and between related works).

Some of the records are used as examples in this master thesis. The aspects reflected in these documents are:

- Documents pertaining to a series
- Documents that have “content parts”
- Documents that have “document parts”

In chapter 7 these aspects are discussed and the terminology is explained.



## 7. COMPARISON OF FRBR AND THE EXPRESSION-PRIORITIZED MODEL

We have looked at how the conceptual models are defined. In this chapter I will discuss some practical examples on how different documents can be modelled in the two data models. Some of the particularities of the two models will be clarified when they are compared. The databases are filled with the data from the examples. Hopefully this will reveal some of the physical consequences of the two models. This chapter is an attempt to bring the discussion to a practical level.

Several examples on modelling of documents in FRBR are given in the FRBR report (IFLA 1998), but none of the examples challenge the model. Most of the documents in a library catalogue are likely to be of a “plain” sort. They are plain in the sense that they comprise only one manifestation to one expression to one work. These documents are easily modelled, and the structure of the bibliographic record would be the same (i.e. one Work record, one Expression record and one Manifestation record) in both the two models presented here. The difference between the two models in these cases is the location and content of some attributes. It is my belief that in these cases, even if the changes are minor, the expression-prioritized model is an improvement of FRBR. I will therefore first give an example on the modelling of a “plain” document.

Next I will give examples on some documents with aspects that will challenge the data models. These documents will often have aggregations or component parts. Taniguchi (2003b) uses two terms borrowed from Tom Delsey (1998) to describe two types of component parts: document part and content part. The document part is a physically separate component of a multipart document, while the content part is not physically independent. Through analyzes of the “Peer Gynt” records two types of content parts were identified. One type is when the content parts are expressed together in a certain succession, this type of content part will be called coexistent content parts, and another type occurs when the content parts are expressed simultaneously, this type of content parts will be called concurrent content parts (this type of content part is described as an integral part in FRBR). The implications for the modelling of these types of content parts will be discussed in this chapter. The modelling of some of the aspects of these documents can not be solved until we have good operational definitions of the bibliographic entities.

When we have tested the data models on challenging documents we will know if either of the databases are better in modelling the relations of the “real world”. We want to be able to do as few compromises as possible when we model these relations.

Examples will be taken from the “Peer Gynt” data described in the previous chapter. Examples on challenging documents will be a collection of the plays of Ibsen, a work pertaining to a series, and a song where both the lyrics and the melody exist as independent works as well as together as a whole. Be aware that the item level is left out of this discussion.

## 7.1 The modelling of different types of documents

### Example one: the “Neil Young example”.

This example shows how a “plain” document might be modelled in FRBR and the expression-prioritized model. The source record is given in figure 7.1.

Figure 0.1 Source record in NORMARC

```
*000nam 2200181 4500/117
*0018903871rmo
*007 a
*008 910429 us x eng
*009 $au
*08200$a839.822
*09000$aNA ad Ibsen, H.$b kj/h (til ib)
*10010$aYoung, Neil
*24504$aThe play of consciousness : an archetypal interpretation of Henrik Ibsen's Peer Gynt $cNeil Young
*26000$aAnn Arbor, Mich.$b University Microfilms International$c1989
*30000$a[3], XXX IX, 347 s.$bill.$c22 cm
*50000$aAvhandling (doktorgrad) - University of California, 1981. - Papirkopi fra mikrofilm
*74000$aThe play of consciousness$w4
*90011$aIbsen, Henrik$tPeer Gynt$fzYoung, Neil. The play of consciousness : an archetypal interpretation of Henrik Ibsen's Peer Gynt
```

This document is a paper copy of a microfilm. It is a Ph.D. (\*500 give us that information). The language code is given in \*008, and the subject in form of a Dewey number is given in \*082. The author is given in \*100, and titles and responsibility designation is given in \*245. \*260 gives the place of publication, publisher, and year of publication, and \*300 gives the extent and dimension of carrier.

Structurally this document is modelled in the same way in FRBR and the expression-prioritized model. We have one Work instance, one Expression instance and one Manifestation instance. When we fill our database with data from this document we see that in two of the tables we get a different result. These two tables are GrpOneEntLink, which links the entities of group One, and the TitleLink table, which links title statements to the group One entities.

Figure 0.2 Excerpt from the GrpOneEntLink table in FRBR

GrpOneEntLink: Tabell					
	IDfrom	typeOfIDfrom	IDto	typeOfIDto	relation
▶		1 E		1 M	IsEmbodiedIn
*	0		0		

Figure 7.2 shows the table GrpOneEntLink for the FRBR model in the Data window of Access. The *typeOfIDfrom* and *typeOfIDto* attributes indicate the entity who owns the *IDfrom* or *IDto* (W

= Work, etc.). The table is read from left to right. The only line of figure 1 is read: expression 1 (i.e. an instance of Expression where the value of the attribute eID is 1) is embodied in manifestation 1. We see that we only have one insertion (i.e. one instance of the entity GrpOneEntLink).

Figure 7.3 shows the same table in the expression-prioritized model. We see that we get two insertions in this model. This is because the *IsRealizedThrough* relationship between Work and Expression in FRBR is expressed as an attribute in the Expression table<sup>5</sup> (wID is foreign key in Expression). This might indicate that the GrpOneEntLink table will be bigger in the expression-prioritized model. However, in the next example, where I model component parts, GrpOneEntLink contains the fewest instances in the expression-prioritized model. This is a result of fewer work instances being created in Taniguchi's model. If the database mostly contains plain documents, this link table might be smaller in FRBR, but if there are many documents consisting of component parts, this difference will even out.

Figure 0.3 The GrpOneEntLink table in the expression-prioritized model

GrpOneEntLink: Tabell					
	IDfrom	typeOfIDfrom	IDto	typeOfIDto	relation
▶	1	E	1	M	IsFixedIn
	1	W	1	E	IsExpressedIn
*	0		0		

Figure 7.4 gives us an excerpt from the Title table and the TitleLink table (shown as a sub table in the figure). We see that here, we have one more insertion in the FRBR database. In the expression-prioritized model, the Manifestation does not have any title statements. When considering the size of the databases it might seem that the two models equals each other, but we know that some works have several titles. If this document had two titles, the TitleLink table of the FRBR base would increase with three instances (one for each bibliographic entity), while the expression-prioritized base it would only increase with two. If we have a database, where 100 of the documents have two titles (which is not unlikely in large databases), and these titles are associated with all the three (or two in the expression-prioritized model) bibliographic entities, the FRBR database would have 200 instances more than the expression-prioritized database. It is therefore reason to believe that we will save valuable disc space with the expression-prioritized model.

<sup>5</sup> The reason why this relationship is modelled this way in FRBR (and not through GrpOneEntLink as in the expression-prioritized model) is that it requires less processing time. When the application system has an expression it immediately knows the work without having to search for a wID in the GrpOneEntLink, since the wID is an attribute of the expression.

Figure 0.4 a) Title and TitleLink in FRBR

Title: Tabell			
titleID	title	subtitle	
1	The play of consciousness	an archetypal interpretation of Henrik Ibsen's Peer Gynt	
	ID	typeOfID	typeOfTitle
	1	W	main
	1	E	main
	1	M	main
*	0		

b) Title and TitleLink in the expression-prioritized model

Title: Tabell			
titleID	title	subtitle	
1	The play of consciousness	an archetypal interpretation of Henrik Ibsen's Peer Gynt	
	ID	typeOfID	typeOfTitle
	1	W	main
	1	E	main
*	0		

Another important point that must be considered is the processing efficiency when retrieving data from the databases. Let us say that we know the work (we have the wID), and want to find all the manifestations of that work. In the FRBR model we first need to go to the Expression table and find the expressions, eIDs, related to that work. Then we go to the GrpOneEntLink table and find the manifestations, mIDs, related to the eIDs found in the previous table. In the expression-prioritized model we only need to check one table, the GrpOneEntLink table, to find the same relationships. This could indicate a higher processing efficiency in the expression prioritized model, but this area needs further investigation. Transaction analyzes on large databases must be conducted before a conclusion on the total processing efficiency can be drawn.

### Example two: the “Henrik Ibsen example”.

I will now give some examples on documents with many aspects and relationships. The modelling of component parts can be extremely complex as we will see. The question is then: are the models good enough to reflect this complexity?

Figure 7.5 gives the NORMARC source record of a document that contain both document- and content parts. It is a multi-volume issue of the plays of Henrik Ibsen, entitled “Plays”. The record is in Norwegian so I will translate the important information. It is noted to be a six-volume issue (\*300\$a 6 b.), but only three of them, volumes 4, 5, and 6, are described with content notes in the record (\*505). For the sake of this example I will act as if it were a three-volume issue (the volumes still being referred to as vol. 4, 5, and 6). Altogether, the three volumes contain seven plays of Ibsen. The MARC field \*440 gives the series designation. Volume 5 and 6 are published as part of the series “World dramatists”, and volume 4 is issued in the series “The master playwrights”. A third series, “Methuen world classics”, is also mentioned. It is not evident if we are dealing with three different series, sub series, or one series that has

changed name two times. I choose to interpret it as the latter, if for no other reason than to keep the example as simple as possible, yet still being able to discuss all the aspects of the document. Problems regarding series will be discussed later in this chapter.

**Figure 0.5 Source record in NORMARC**

```
*000nam 2200385 4500/121
*0018705055nno
*008910429 gb eng
*009 $ain
*020 $a0-413-46360-5$bh.$gb. 4
*020 $a0-413-60490-X$bh.$gb. 5
*020 $a0-413-15300-2$bh.$gb. 6
*0411 $aengnor
*08230$a839.822[S]
*090 $aNA/Ibsen, H.
*098 $ak
*10010$aIbsen, Henrik$d1828-1906
*24510$aPlays$cHenrik Ibsen ; translated from the Norwegian and introduced by Michael Meyer
*260 $aLondon$bMethuen$c1980-1987
*300 $a6 b.$c28 cm
*440 4$aThe Master Playwrights
*440 0$a[World Dramatists]
*440 0$a[Methuen world classics]
*505 $aB. 5-6 utgitt i serien World dramatists
*505 $aSenere opptrykk utgitt av Methuen Drama i serien Methuen world classics
*505 $a4 : The pillars of society ; John Gabriel Borkman ; When we dead awaken - 1980. - 269 s. - Originaltitler: Samfundets støtter ; John Gabriel Borkman ; Når vi døde vågner
*505 $a5 : Brand ; Emperor and Galilean. - 1986. - 300 s. - Originaltitler: Brand ; Kejser og Galilæer ;
*505 $a6 : Peer Gynt ; The pretenders. - 1987. - 287 s. - Originaltitler: Peer Gynt ; Kongs-  
emne  
*70011$aMeyer, Michael$eovers.
*7300 $aSamfundets støtter
*7300 $aJohn Gabriel Borkman
*7300 $aNår vi døde vågner
*7300 $aBrand
*7300 $aKejser og Galilæer
*7300 $aPeer Gynt
*7300 $aKongs-emne
*7404 $aThe Pillars of society
*7400 $aJohn Gabriel Borkman
*7400 $aWhen we dead awaken
*7400 $aBrand
*7400 $aEmperor and Galilean
*7400 $aPeer Gynt
*7404 $aThe pretenders
```

Each volume is a document part of the work “Plays” as a whole. The volumes might have distinct names, but they are still dependent on the context of the larger work for their identification. With the FRBR terminology, the Work and Expression records of each volume are segmental parts of the larger work. The manifestations of the volumes are discrete physical units of the

manifestation of “Plays”. Each individual play (i.e. Peer Gynt, The pretenders, etc.) is a content part of the volume.

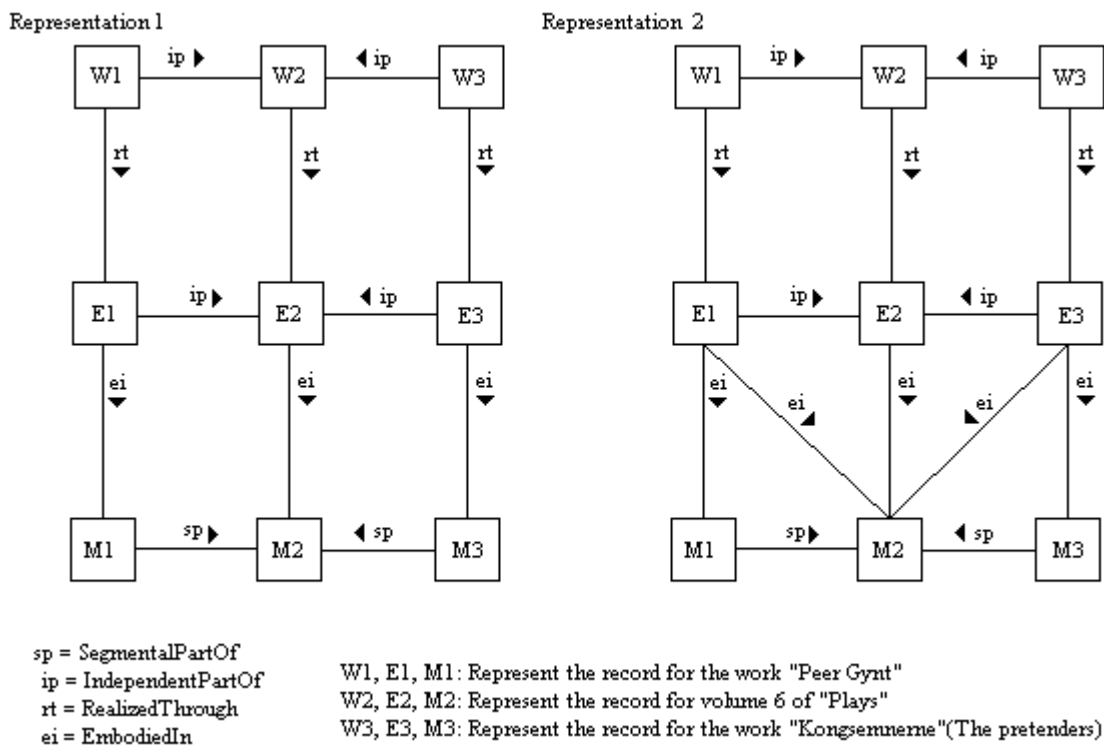
In the FRBR report it is taken for granted that the work representing the whole is an independent work. This is not the case here, since the work representing the whole is one of the volumes, the volumes being dependent part of “Plays”. Each play is an independent part of the volume they are embodied in. For example, Peer Gynt is an independent work and is certainly not dependent on the context of the volume for its identification. On the Manifestation level of the volumes, on the other hand, the part records (containing location within host, responsibility designations for the part, etc.) are not independent of the whole. The FRBR report describes two categories of dependent parts on Manifestation level: discrete physical units and integral parts. Neither of them fit this relationship. The part manifestations are not physically separated from their host, neither are they interwoven as integral parts (e.g. like the soundtrack of a film that is embedded in the film). It seems more appropriate to classify them as segmental parts since they are discrete components within the manifestation. This is the type of content part that I have named coexistent content parts above.

As we see, the relations are rather complex. It is difficult to grasp all the aspects in one. I will start the discussion with the modelling of one of the volumes (volume six) and its content parts.

According to the definitions of the two models there are basically two ways of modelling this kind of component document if we want to implement all the entities involved. On the basis of these two ways, we have a number of variations, depending on which relationships and entities (i.e. part-entities) we want to implement. There are fewer possible variations in the FRBR model than in the expression-prioritized model.

Figure 7.6 shows the two main ways of modelling the relationships between a host document and its component parts in the FRBR model.

Figure 0.6 The modelling of vol. 6 in FRBR



In the first example of figure 7.6 (representation 1), only the whole/part relationships between the content parts (Peer Gynt and The pretenders) and the host item (volume 6) are implemented. In the second example (representation 2), all possible relationships between these entities are drawn. On the basis of representation 2 I will discuss the possible variations, which are all simplifications in one way or another of the model.

*Variation one: The entities E1, M1, E3, M3 and their relationships are not implemented.*

This result in the structure described in the Neil Young example above, except that the whole/part relationship between the works are implemented<sup>6</sup>. The advantage of this model is that it is simple, yet it still gives us the possibility to navigate between works that are related in different ways. On the other hand a lot of information about the document would have to be placed in notes (e.g. the location of the component part within the host, responsibility designations for the component part if it differs from that of the host, etc.). This is what we do in MARC records, the contents notes and relationships are written in note fields. In a MARC record we have no choice, but in FRBR we do. It is also worth noting that W2 is an “artificial work”, at least that is one possible interpretation of it. The two works “Peer Gynt” and “Kongsemnerne” (The pretenders) have been put together in a manifestation. The two works are unaltered, and putting them together does not make them a new work. Another argument for this viewpoint is that since Henrik Ibsen is the creator of the two individual works, he is also the creator of the “artificial work”, but this artificial work is created in 1987 (\*505 of the MARC record in figure 7.5), which would make this something of a small miracle to say the least.

<sup>6</sup> In this variation it might seem like the part works (W1 and W3) do not have any expressions or manifestations, which is not possible in FRBR. Naturally they have other expressions and manifestations that do not relate to the document that is being modelled here, otherwise this variation would not be possible.

*Variation two: The entities W2, E2, are not implemented.*

Alternatively M1 and M3 and their relationships are not implemented and note fields are used instead.

Still we have a simple model with few entities. In this model we avoid the artificial work W2, but we also lose the collective expression E2 since it is not possible to have an expression without a work level in FRBR. This indicates that we see the volume six of “Plays” as a manifestation that embodies several expressions. No whole/part relationships are created on the Work and Expression levels. The extent of the collective expression (which is an attribute of the Expression) must be calculated since we have no natural place to record this information. On the other hand this might not be such a huge loss. What is worse is that instead of having a collective expression where we can place information about language, translator, form of expression, etc., this information is repeated for every expression that is embodied in the manifestation. If all the expressions embodied in a manifestation were gathered in a specific context (which is an attribute at the Expression level) we would not be able to record this data in a satisfactory way. This will mean a lot of redundancy in the database if these attributes hold the same value for every expression collected in the manifestation.

*Variation three: The entities M1 and M3 and their relationships are not implemented.*

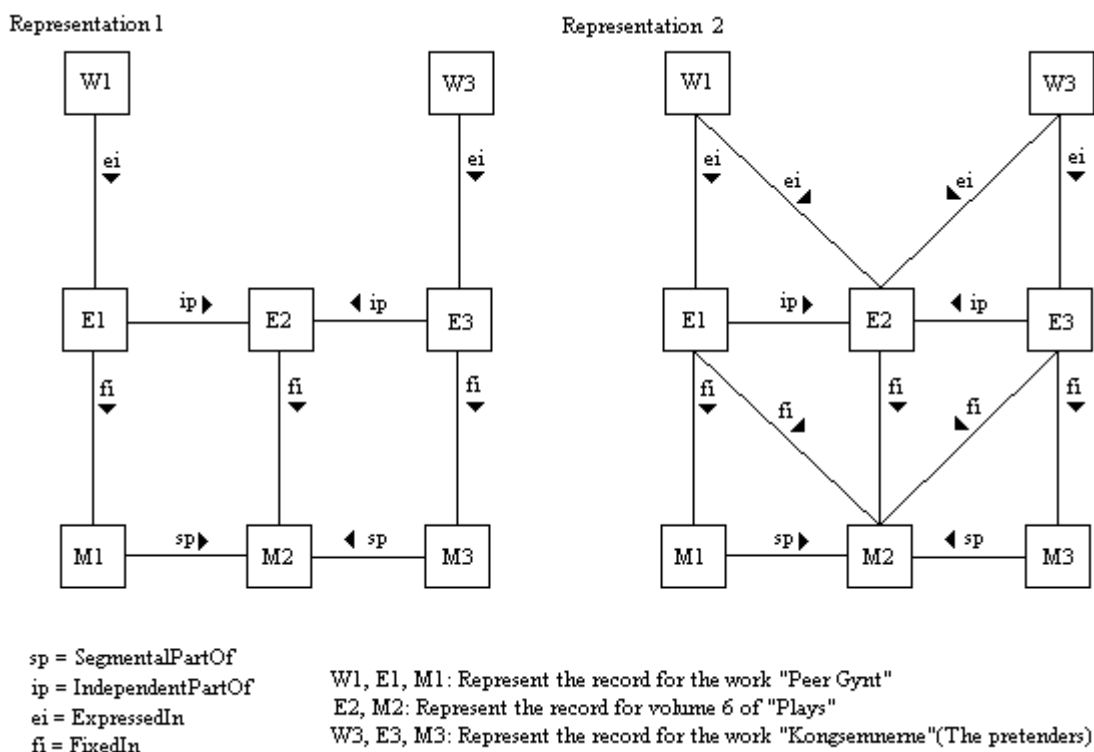
It might seem unnecessary to discuss this variation as a particular case, when the only difference from representation 2 is that it lacks the part manifestations, an aspect that has been discussed in both the previous variations. It is true that for this kind of content part where two works are manifested together it does not seem to be any implications other than that some information, like the location within host etc., is placed in note fields as I have mentioned above. But when working with the Peer Gynt records it has become apparent that the content parts must be further subdivided. Sometimes two independent works are expressed simultaneously. For example, when a song where the lyrics and the music both exist as independent works is performed. The two works are not simply manifested together, they are performed (expressed) simultaneously. When we have this kind of content part (referred to as concurrent content parts above) it seems this variation has some implications that might be of importance. This type of content part will be discussed in the next example, “the Solvejg’s song example”.

I will now discuss the two main representations (shown in figure 7.6). In both representations all the entities are implemented. The difference between them is that in representation 2, the relationship *IsEmbodiedIn* is implemented between E1 and M2, and E3 and M2. Both representations are possible according to the definitions given in the FRBR report. The two extra relationships of representation 2 gives us better possibilities to navigate in a result set, but are they really necessary? If we remove M1 and M3 we are obliged to implement them, but when M1 and M3 are implemented we do have a choice. The question of which model is better can only be answered fully when we have an application program to the database. This is beyond the scope for this thesis, but would be a natural next step.

Below, where I fill the database with data from this document, I have chosen to implement all the entities of the component parts, but as few relationships as possible (i.e. representation 1 in both the FRBR model and the expression-prioritized model).

I will now discuss the corresponding two main representations of the expression-prioritized model. They are shown in figure 7.7 (note that the terminology is slightly different from the FRBR terminology).

Figure 0.7 The modelling of vol. 6 in the expression-prioritized model



We see that the artificial work W2 is not created since I have chosen the policy of creating a work in limited cases. This might indicate that we will get a smaller database. But a smaller database is not necessarily good if we lose some important data and relationships. It is therefore important to see if this is the case.

The *W1 IsExpressedIn E2* and *W3 IsExpressedIn E2* relationships reflect the fact that an expression may express several works, in contrast to only one as is the case in FRBR. We saw that in the FRBR model there were two ways of modelling the relationship between W1 and E2, either through W2 (if we do not wish to create the records for the content parts) or through both W2 and E1. In the expression-prioritized model there are three ways of modelling the same relationship, either directly (*W1 IsEmbodiedIn E2*), through E1 (*W1 IsExpressedIn E2 IsIntegralPartOf E2*), or we implement both relationships. If we choose the policy of creating a Work instance for every document to be catalogued we would further have a couple of possibilities. These are all possible solutions according to the definitions of FRBR and thus also of the expression-prioritized model. Which solution is preferable is partly a definitional problem, partly a conceptual problem. The questions that need to be answered are: Do we see E2 as an

expression of W1 and W3 or do we see E2 as a collection of the expressions of W1 and W3? View points on these aspects will be presented in the discussion of the variations below. These aspects are of particular interest when we have concurrent content parts as we will see.

*Variation one: The entities E1, M1, E3, and M3 and their relationships are not implemented.*

If we do not want to create content parts on the Expression and Manifestation level this is the way we must model the relationships between the entities. On the conceptual level E2 is seen as an expression of W1 and W3, or to put it in other words: *W1 IsExpressedIn E2*, which is true (W1 is expressed in E2 even though it is only a part of the whole expression), and *W3 IsExpressedIn E2*, also true. Therefore it seems that this is a conceptually correct way to model this relationship if we want to simplify our model. This gives us a more direct way of modelling the relationship between W1/W3 and E2 than in the same variation in the FRBR model.

*Variation two: The entity E2 and its relationships are not implemented.*

Alternatively M1 and M3 can be left out (instead the notes field of M2 is filled with their data).

This variation is structurally the same as variation two in the FRBR model, but the implications for the expression-prioritized model diverge since the attributes of Expression and Manifestation are different. Taniguchi (2003a) proposed to model a coexistent content part this way. He used an example of a CD containing two independent works.

Taniguchi writes:

“Let us think about the cases where a manifestation/medium instance embodies more than one expression/text. When an item corresponding to such a manifestation [...] bears a collective title [...], each expression/text instance would have that collective title as well as a title corresponding to its own text”(ibid., p. 29)

This will lead to a lot of redundancy in our database. Title statements found in a document belong to the Expression. The collective title would be repeated in our database for as many times as there are component parts. An even larger problem would be to decide which of the titles of an expression to choose as main title, the collective title or the individual title. If we imagine that the expression is part of several collections, the confusion of title statements would be total. This would also lead to great difficulties in how a result set of this kind of documents should be presented in a programmed interface.

The same problem with extent and language of expression discussed in variation two of FRBR will appear here. We would not have a natural place to record information about the extent or language of the collective expression

*Variation three: The entities M1 and M3 and their relationships are not created. The relationships W1 IsExpressedIn E2 and W3 IsExpressedIn E2 are or are not created.*

The implications for the *W1 IsExpressedIn E2* and *W3 IsExpressedIn E2* are discussed in variation one and will not be repeated. The implications for the *E1 IsFixedIn M2* and *E3 IsFixedIn M2* relationships are similar to the implications for the Work level. E1 is fixed in M2, even though it

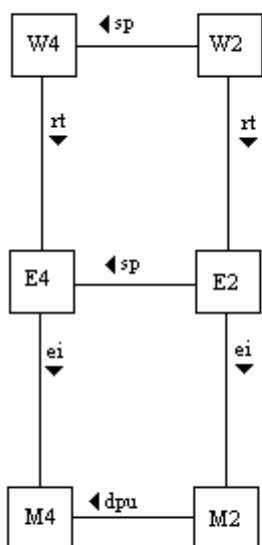
is only one of the expressions fixed in the manifestation. So if we do not want to create manifestation records for the document part, this way of modelling the relationships is correct.

Let us now look at the relationship between “Plays” as the host, and volume six as the document part. In accordance with the previous discussion, as few relationships as possible are implemented, i.e. only the whole/part relationships.

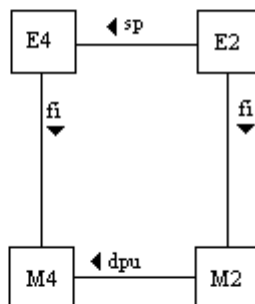
In FRBR we must create a Work record for “Plays”, while in the expression-prioritized model we do not need one. We therefore have six entities involved in this relation in FRBR, and four entities involved in the expression-prioritized model. This is shown in figure 7.8. The notation is continued from the previous example. Volume six is still (W2), E2, M2, and the host, “Plays”, is (W4), E4, M4. Note that the records for the individual plays are also implemented, but they are not shown to make the figure easier to read.

Figure 0.8 The relationship between "Plays" and "volume six"

FRBR



The expression-prioritized model



sp = SegmentalPartOf  
 dpu = DiscretePhysicalUnitOf  
 rt = RealizedThrough  
 ei = EmbodiedIn  
 fi = FixedIn

(W4), E4, M4: Represent the record for "Plays"  
 (W2), E2, M2: Represent the record for volume 6 of "Plays"

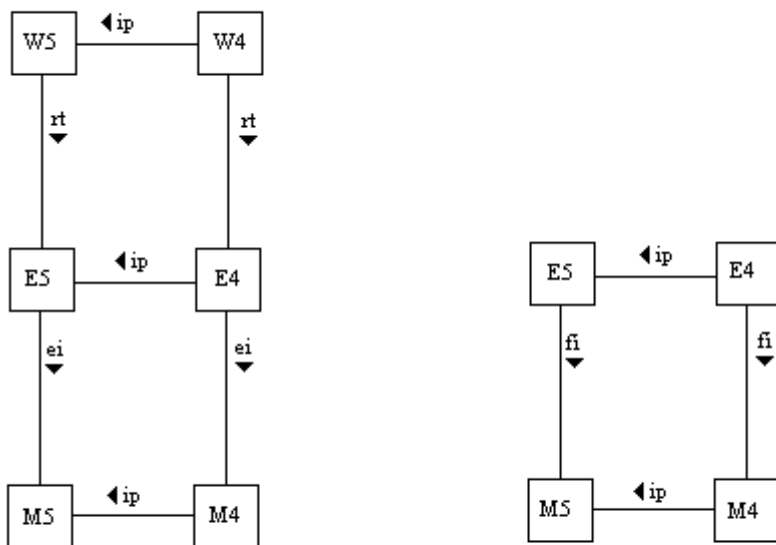
The work “Plays” is part of a series called “Methuen world classics”. The main problem with a series is that it does not really have a manifestation. The manifestation of a series comprises all individual manifestations issued in the series. Never the less we need someplace to put information about ISSN (International Standard Serial Number). A Manifestation record is therefore created for the series.

It is a bit unclear if we need to create a work for the series in the expression-prioritized model. The question is: do series have a creator, or only an editor. The editor can be placed at the Expression level. I have chosen not to implement the Work record for the series in the expression-prioritized model. Figure 7.9 shows the relationships between the series and "Plays".

Figure 0.9 The relationships between the series and "Plays"

FRBR

The expression-prioritized model



ip = IndependentPartOf (W4), E4, M4: Represent the record for "Plays"  
 rt = RealizedThrough (W5), E5, M5: Represent the record for the series "Methuen world classics"  
 ei = EmbodiedIn  
 fi = FixedIn

The data from *volume six*, *Plays*, and *Methuen world classics* were filled into the databases. Before I present the result I will describe a couple of practical solutions that have been made. In my FRBR database, the relationship *M4 is an independent part of M5* is implemented in the SeriesLink table. In my expression-prioritized database the relationship *E4 is an independent part of E5* is expressed in the SeriesLink table. Since I do not have the document in front of me, only the NORMARC record, I have assumed that the title statement "Peer Gynt; The Pretenders" is found in volume six. Only the title "Methuen world classics" is assigned to the series. This gives us six title statements that are related to the different entities (see figure 7.10).

**Figure 0.10 The Title table**

Title: Tabell			
	titleID	title	subtitle
+	1	Peer Gynt	
+	2	Kongsemnerne	
+	3	The pretenders	
+	4	Plays	
+	5	Peer Gynt; The pretenders	
▶	7	Methu en world classics	

In FRBR, title statements are related to Work, Expression, and Manifestation. In the expression-prioritized model, only Work and Expression have title statements.

Let us look at the important tables of the databases. They are shown in table 7.1. In the FRBR base we need to create five instances in the Work table, while only two instances are created in the expression-prioritized model. The table that links the titles to the bibliographic entities, TitleLink, is significantly smaller in the expression-prioritized model where we have 7 instances as opposed to the 15 instances in the FRBR database. Also the table that links the bibliographic entities, GrpOneEntLink, is smaller in the expression-prioritized model (if representation 2 of figure 7.6 and 7.7 were chosen this table would still be smaller in the expression-prioritized model, the number of instances would then be 33/26). To sum it all up, these three tables give a total difference of 13 instances in the two databases. Still the same aspects of the document are modelled in both the databases.

**Table 0.1 Entities and number of instances in the two databases**

Table	Instances
	FRBR / expression-prioritized
Work	5 / 2
TitleLink	15 / 7
GrpOneEntLink	16 / 14

### Example three: The “Solvejg’s song example”.

Here I will give an example of a document containing concurrent document parts. The source record is given in figure 7.11.

Figure 0.11 Source record in NORMARC for Solvejg's song

```
*000nam 2200337 4500
*001930039lnln
*007 s
*008970225 de n
*010 $a9400063
*0280 $aSBK 53257$bSony Classical
*090 $aLyd f/1660
*100 $aGrieg, Edvard
*2400 $aOrkestermusikk. Utvalg
*24510$aPeer Gynt suites no. 1 & no. 2 ; Norwegian dance no. 2 ;
Homage march$cEdvard Grieg$hlydopptak
*260 $aHamburg$bSony Classical$c1993
*300 $al plate$bdigital$c12 cm
*500 $aElisabeth Söderström, sopran ; New Philharmonia
Orchestra, dirigent: Andrew Davis ; Philadelphia
Orchestra, dirigent: Eugene Ormandy
*500 $aInnspilt: London og Philadelphia: 1967, 1968 og 1976

*500 $aInnhold:
[Peer Gynt suite no. 2, op. 55[...]
V. Solvejg's song/Solvejgs lied / vocal part have been added to the
original suite]

*500 $aSony: SBK 53257
*700 l$aSöderström, Elisabeth
*700 l$aDavis, Andrew
*700 l$aOrmandy, Eugene
*710 0$aNew Philharmonia Orchestra
*710 0$aPhiladelphia Orchestra
*7400 $aZwei elegische Melodien
*7400 $aGangar (Grieg)
*7400 $aNotturmo (Grieg)
*7400 $aHuldigungsmarsch
*700 0$aGrieg, Edvard$t[Peer Gynt. Suiter, nr 1-2]
```

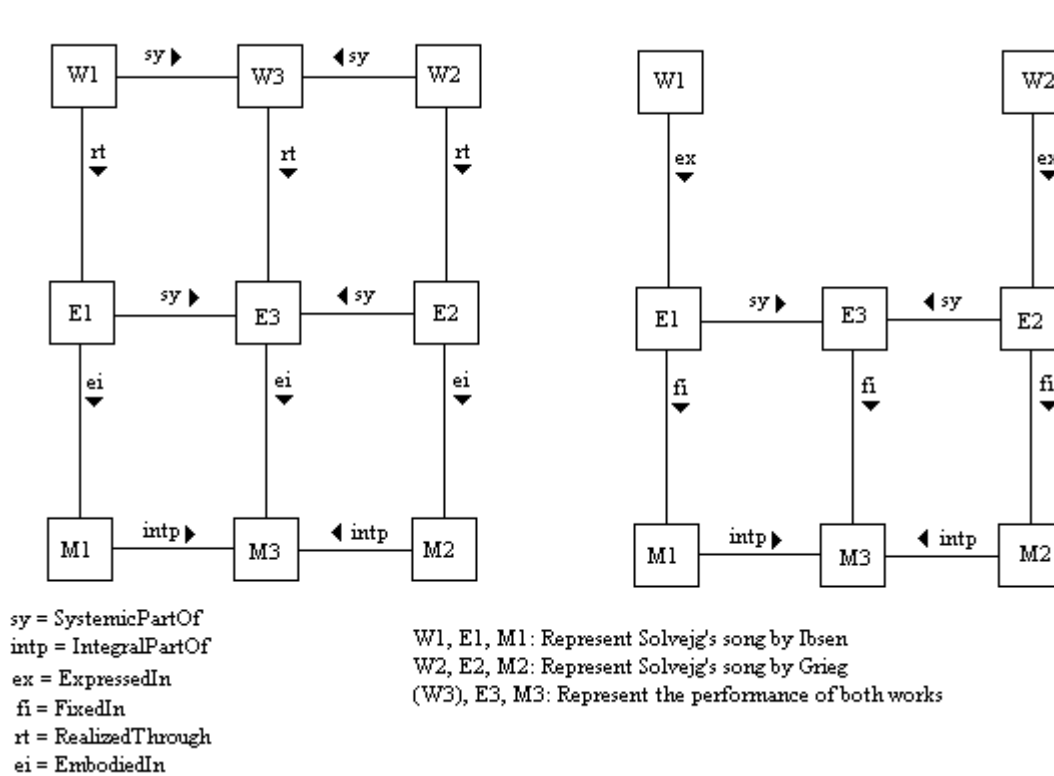
The content note \*500 has been edited to describe only the parts that we are interested in (encapsulated in brackets in figure 7.10).

A CD entitled “Peer Gynt Suites I & 2; Norwegian Dance No. 2; Homage March” contains a performance of “Solvejg’s song”. It is track number nine on the CD. It is this track that is of interest here. The lyrics are written by Henrik Ibsen, and the music is written by Edvard Grieg. Both are works that exist independently, but here they are performed together. The vocal parts have been added to the original suite and are performed by Elisabeth Söderström. The music is performed by New Philharmonia Orchestra.

The two independent works are content parts of track number nine, but it is a different kind of content part than we had in the Henrik Ibsen example. Now the content parts are intertwined,

they are performed simultaneously. On Work and Expression level they are systemic parts, and on Manifestation level they are integral parts with the FRBR terminology. Figure 7.12 shows the modelling of these content parts. It is the same as in the previous example, but there are some problems.

Figure 0.12 The modelling of Solvejg's song



Here, the relationship *E1 IsEmbodiedIn/IsFixedIn M3* is wrong. The same goes for E2. E1 is not manifested in M3, it is only the combination of E1 and E2 (i.e. E3) that is manifested in M3. The same goes for the Work level in the expression-prioritized model. E3 is not an expression of W1, it is an expression of both W1 and W2 at the same time. Therefore, if we want to simplify the modelling, leaving out E1, M1, E2, and M2, and only keep the relationships to W1 and W2, we are forced to create a Work record for track number nine also in the expression-prioritized model. In this type of integral parts as M1 and M2 represent here, we do not have much data to fill the records with. There is no location within host, the track length would always be the same for the parts and the whole, and responsibility for the physical aspects would be the same. In FRBR we have the attributes title statements and responsibility designations on the manifestation level. These could differ and therefore be filled into the part manifestations, but this information would really describe the intellectual content and not the manifestation.

## 7.2 Summary of comparison

In this chapter, two types of content parts are described: coexistent content parts and concurrent content parts.

A coexistent content part and a concurrent content part can not be modelled in the same way. In the former, every relationship of figures 7.6 and 7.7 can be implemented. In the latter, only representation I of the same figures is possible.

Sometimes the Manifestation records of concurrent content parts will not contain any data.

With the expression-prioritized model we avoid the creation of what I have called “artificial works”. This gives us a smaller database, and it is likely that we will save disc space even if the documents are modelled solely as integral units.

It seems the same relationships can be modelled in both the two models, even when the expression-prioritized model has fewer instances of some of the entities. However, we need better definitions for Work, Expression, and Manifestation before the aspects of content parts can be fully understood and modelled.

The modelling of whole/part relationships (and also other types of linear relationship types like “is a reproduction of”, “is a successor to”, etc.) can be expressed in a way that is readable by an application program. This gives the user a possibility to navigate in a result set through these relationships.

Series are problematic. They do not seem to have a manifestation. Not in the same way as a book has a manifestation. It is unclear if series have anything but an expression. A question that might be posed is: ISSNs uniquely identifies titles, is it possible that this information might be placed on the Expression level?

## 8. Conclusions and further work

### 8.1 Conclusions

I have presented two databases based on FRBR. One is based on the final report of IFLA (1998) and the other is based on Taniguchi's expression-prioritized model, presented in "A conceptual model giving primacy to text-level bibliographic entity in cataloging" (Taniguchi 2003a) and "Conceptual modeling of component parts of bibliographic resources in cataloging" (Taniguchi 2003b).

The databases are not complete in the sense that they can be used in a library or other similar institutions. Hopefully they will give an idea on how a database based on FRBR might look like, and this might be of help when trying to locate problems for further studies on the model.

The two databases were compared with regard to their ability to handle some complex relationships of a document and to physical aspects that might influence processing efficiency and the physical secondary storage of the data.

The result of the comparison might indicate that we will get a smaller and more efficient database with the expression-prioritized model. We do not need to create what I have called "artificial works", and titles are only associated with the Work and the Expression. However, some title statements obviously belong to the manifestation level. This is not possible to reflect in the expression-prioritized model.

Both models give good possibilities of modelling complex relationships. It seems that the same relationships can be modelled in both the databases. The expression-prioritized model presents a new way of modelling the relationships between the independent works of a collection (cf. figure 4.6).

The modelling of concurrent content parts and series poses some problems that must be discussed further. Do series really have a manifestation? The same question might also be posed regarding concurrent content parts. Another question is: are there any relationships between the expression of the series and the manifestations of the individual documents of the series?

The expression-prioritized model has a clearer distinction between the bibliographic entities that describe the intellectual content (Work and Expression) and the entities that describe the physical carrier (Manifestation and Item). This might contribute to an easier understanding of the division of the bibliographic entities, and it might make it easier, when teaching FRBR, to explain why they are divided into four levels and what these levels represent.

When summing it up, it is my belief that the expression-prioritized model is an improvement of FRBR, and should be considered when revising the model.

### 8.2 Further work

Professor Taniguchi proposes to assign more information to the expression level than what was originally proposed in the FRBR report. The discussion on how much information should be

associated with the Expression must be continued until we have an accurate definition of the entity.

It is also interesting to know how the changes to the FRBR model proposed in the expression-prioritized model would affect searches in the database and the presentation of search results. Application programs adapted to the two models must be built so that the consequences of the expression-prioritized model can be made clear.

I have only discussed the modelling of three documents. Moore documents need to be discussed and modelled, and the databases must be tested on a large amount of documents to see if the indications presented here holds true.

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## 10. Appendix

### 10.1 Appendix A: Single or multi-valued attributes in FRBR

This appendix contains the mapping of single and multi-valued attributes in FRBR. Some of the attributes can fall in either of the categories depending on the point of view. Some of the attributes labelled multi-valued here, might be interpreted as single-valued by others. The tables below also indicate the attributes that are not implemented in this thesis.

#### Group One Entities

##### Work

Attribute	Multi-valued (M), or not multi-valued (NM).
Title of the Work	(M)
Form of Work	(NM)
Date of the Work	(NM)
Other Distinguishing Characteristic	(M)
Intended Termination	(NM)
Intended Audience	(M)
Context for the Work	(M)
Medium of Performance (Musical Work)	(M)
Numeric Designation (Musical Work)	(M)
Key (Musical Work)	(NM) Left out of my model.
Coordinates (Cartographic Work)	(M) Left out of my model.
Equinox (Cartographic Work)	(NM) Left out of my model.

##### Expression

Title of the Expression	(M)
Form of Expression	(M)
Date of Expression	(NM)
Language of Expression	(M)
Other Distinguishing Characteristic	(M)
Extensibility of Expression	(NM)
Revisability of Expression	(NM)
Extent of the Expression	(NM)
Summarization of Content	(NM)
Context for the Expression	(M)
Critical Response to the Expression	(M)
Use Restrictions on the Expression	(M)
Sequencing Pattern (Serial)	(NM)
Expected Regularity of Issue (Serial)	(NM)
Expected Frequency of Issue (Serial)	(NM)

Type of Score (Musical Notation)	(NM)
Medium of Performance (Musical Notation or Recorded Sound)	(M)
Scale (Cartographic Image/Object)	(NM) Left out of my model.
Projection (Cartographic Image/Object)	(NM) Left out of my model.
Presentation Technique (Cartographic Image/Object)	(NM) Left out of my model.
Representation of Relief (Cartographic Image/Object)	(NM) Left out of my model.
Geodetic, Grid, and Vertical Measurement (Cartographic Image/Object)	(M) Left out of my model.
Recording Technique (Remote Sensing Images)	(M) Left out of my model.
Special Characteristic (Remote Sensing Images)	(M) Left out of my model.
Technique (Graphic or Projected Image)	(M) Left out of my model.

## Manifestation

Title of the Manifestation	(M)
Statement of Responsibility	(NM)
Edition/Issue Designation	(NM)
Place of Publication/Distribution	(M)
Publisher/Distributor	(M)
Date of Publication/Distribution	(NM)
Fabricator/Manufacturer	(M)
Series Statement	(M)
Form of Carrier	(M)
Extent of the Carrier	(M)
Physical Medium	(M)
Capture mode	(NM)
Dimensions of the Carrier	(NM)
Manifestation Identifier	(M)
Source of Acquisition/Access Authorization	(M)
Terms of Availability	(M)
Access Restrictions on the Manifestation	(M)
Typeface (Printed Book)	(M)
Type Size (Printed Book)	(M)
Foliation (Hand-Printed Book)	(NM) Left out of my model.
Collation (Hand-Printed Book)	(NM) Left out of my model.
Publication Status (Serial)	(NM)
Numbering (Serial)	(M)
Playing Speed (Sound Recording)	(NM)
Groove Width (Sound Recording)	(NM) Left out of my model.
Kind of Cutting (Sound Recording)	(NM) Left out of my model.
Tape Configuration (Sound Recording)	(NM)
Kind of Sound (Sound Recording)	(NM) Left out of my model.

Special Reproduction Characteristic (Sound Recording)	(NM)
Colour (Image)	(M) Left out of my model.
Reduction Ratio (Microform)	(NM) Left out of my model.
Polarity (Microform or Visual Projection)	(M) Left out of my model.
Generation (Microform or Visual Projection)	(NM) Left out of my model.
Presentation Format (Visual Projection)	(NM) Left out of my model.
System Requirements (Electronic Resource)	(M) Left out of my model.
File Characteristics (Electronic Resource)	(M) Left out of my model.
Mode of Access (Remote Access Electronic Resource)	(M) Left out of my model.
Access Address (Remote Access Electronic Resource)	(M) Left out of my model.

### Item (The entire entity is left out)

Item Identifier	(NM) Left out of my model.
Fingerprint	(NM) Left out of my model.
Provenance of the Item	(NM) Left out of my model.
Marks/Inscriptions	(M) Left out of my model.
Exhibition History	(M) Left out of my model.
Condition of the Item	(NM) Left out of my model.
Treatment History	(NM) Left out of my model.
Scheduled Treatment	(M) Left out of my model.
Access Restrictions on the Item	(M) Left out of my model.

## Group Two Entities

### Person

Name of Person	(M)
Dates of Person	(NM)
Title of Person	(M)
Other Designation Associated with the Person	(M)

### Corporate Body

Name of the Corporate Body	(M)
Number Associated with the Corporate Body	(NM)
Place Associated with the Corporate Body	(M)
Date Associated with the Corporate Body	(NM)
Other Designation Associated with the Corporate Body	(M)

## Group Three Entities

Concept	(NM)
Object	(NM)
Event	(NM)
Place	(NM)

## 10.2 Appendix B: Alphabetical list of tables and attributes.

After the normalization we are left with 43 tables. The list could easily be longer or shorter, depending on the particular need. For example, a LanguageLink table could preferably be created to link the Language table to the Expression table. The Language table could then contain the ISO standard list of language codes which would be linked to the Expression table through the LanguageLink table. Then we would only need to write each language code one time in our database. Thus we reduce redundancy, and the database would be easier to update if changes in the language codes occurs.

### The tables of the FRBR database:

Table 1:	<b>AcqLink</b> ( <u>mID</u> , <u>acqID</u> )
Table 2:	<b>AcquisitionSource</b> ( <u>acqID</u> , source)
Table 3:	<b>Availability</b> ( <u>availID</u> , condition)
Table 4:	<b>AvailLink</b> ( <u>mID</u> , <u>availID</u> , fromDate, toDate)
Table 5:	<b>Context</b> ( <u>conID</u> , context)
Table 6:	<b>ContextLink</b> (ID, <u>typeOfID</u> , <u>conID</u> )
Table 7:	<b>ControlNumber</b> (number, <u>mID</u> , typeOfNum)
Table 8:	<b>CorporateBody</b> ( <u>crpID</u> , number, place, dateCrp, other)
Table 9:	<b>CriticalResponse</b> ( <u>respID</u> , eID, criticism)
Table 10:	<b>CrpBodyName</b> ( <u>crpNameID</u> , name, subdivision)
Table 11:	<b>CrpNameLink</b> ( <u>crpID</u> , <u>crpNameID</u> , fromDate, toDate, typeOfName)
Table 12:	<b>Expression</b> ( <u>eID</u> , eDate, extent, expand, revise, abstract, sequencingPattern, regularity, frequency, typeOfScore, otherInfo, wID)
Table 13:	<b>Form</b> ( <u>formID</u> , form)
Table 14:	<b>FormLink</b> ( <u>eID</u> , <u>formID</u> )
Table 15:	<b>FormOfCarrier</b> ( <u>carrierID</u> , formOfCarrier)
Table 16:	<b>FrmOfCarManifLink</b> ( <u>carrierID</u> , <u>mID</u> )
Table 17:	<b>GrpOneAndTwoLink</b> ( <u>grpOneID</u> , typeOfIDone, <u>grpTwoID</u> , typeOfIDtwo, relation)
Table 18:	<b>GrpOneEntitiesLink</b> ( <u>IDfrom</u> , typeOfIDfrom, <u>IDto</u> , typeOfIDto, relation)
Table 19:	<b>IntAudience</b> ( <u>audiencID</u> , groupName)
Table 20:	<b>IntAudienceLink</b> (ID, typeOfID, <u>audiencID</u> )
Table 21:	<b>Language</b> ( <u>eID</u> , language)
Table 22:	<b>Manifestation</b> ( <u>mID</u> , responsible, edition, dateOfPubl, extOfCarrier, dimOfCarr, captureMode, typeFace, typeSize, publStatus, playingSpeed, tapeConfig, specReprodChar)
Table 23:	<b>MediumOfPerformance</b> ( <u>medOfPerfID</u> , instrument)
Table 24:	<b>MediumOfPerfLink</b> (ID, typeOfID, <u>medOfPerfID</u> , number)
Table 25:	<b>NumberDesignation</b> ( <u>numID</u> , wID, designation)
Table 26:	<b>OtherDistChar</b> ( <u>charID</u> , ID, typeOfID, distChar)
Table 27:	<b>Person</b> ( <u>personID</u> , bornDate, deadDate, other)
Table 28:	<b>PersonName</b> ( <u>pNameID</u> , name)
Table 29:	<b>PersonNameLink</b> ( <u>personID</u> , <u>pNameID</u> , fromDate, toDate, typeOfName)
Table 30:	<b>PersonTitle</b> ( <u>pTitleID</u> , pTitle)
Table 31:	<b>PersonTitleLink</b> ( <u>personID</u> , <u>pTitleID</u> , fromDate, toDate)
Table 32:	<b>PhysicalMedium</b> ( <u>physMediumID</u> , physicalMedium)

Table 33:	<b>PhysMediumLink</b> ( <u>mID</u> , <u>physMediumID</u> )
Table 34:	<b>PlaceOfPublication</b> ( <u>placeID</u> , <u>placeName</u> )
Table 35:	<b>PlacePubLink</b> ( <u>mID</u> , <u>placeID</u> )
Table 36:	<b>SeriesLink</b> ( <u>mIDfrom</u> , <u>mIDto</u> , <u>partNumber</u> )
Table 37:	<b>Subject</b> ( <u>subjectID</u> , <u>term</u> , <u>typeOfTerm</u> )
Table 38:	<b>SubjectLink</b> ( <u>wID</u> , <u>subjectID</u> )
Table 39:	<b>Title</b> ( <u>titleID</u> , <u>title</u> , <u>subtitle</u> )
Table 40:	<b>TitleLink</b> ( <u>ID</u> , <u>typeOfID</u> , <u>titleID</u> , <u>typeOfTitle</u> )
Table 41:	<b>UseResLink</b> ( <u>ID</u> , <u>typeOfID</u> , <u>restrID</u> )
Table 42:	<b>UseRestrictions</b> ( <u>restrID</u> , <u>limitation</u> )
Table 43:	<b>Work</b> ( <u>wID</u> , <u>form</u> , <u>wDate</u> , <u>typeOfWork</u> , <u>otherInfo</u> )

Only two of the tables of the expression-prioritized database have attributes that are different from the FRBR database. This is table 12: Expression, and table 36: SeriesLink. In table 18: GrpOneEntLink and table 22: Manifestation we have the same attribute names, but the domains have been changed.

#### The Expression table and the SeriesLink table of the expression-prioritized database:

Table 12:	<b>Expression</b> ( <u>eID</u> , <u>eDate</u> , <u>responsible</u> , <u>edition</u> , <u>extent</u> , <u>expand</u> , <u>revise</u> , <u>abstract</u> , <u>sequencingPattern</u> , <u>regularity</u> , <u>frequency</u> , <u>typeOfScore</u> , <u>otherInfo</u> )
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Table 36:	<b>SeriesLink</b> ( <u>eIDfrom</u> , <u>eIDto</u> , <u>partNumber</u> )
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### 10.3 Appendix C: Entities that are merged in the global view.

#### ContextLink

The tables Context and ContextLink relate to both Work and Expression.

Work view	Context ( <u>conID</u> , context) ContextLink ( <u>wID</u> , <u>conID</u> )
Expression view	Context ( <u>conID</u> , context) ContextLink ( <u>eID</u> , <u>conID</u> )

Context is the same in both views so no changes are necessary for that entity. The attributes wID, and eID of ContextLink are merged, and the attributes ID and typeOfID are derived (the domain for typeOfID is W, E).

#### ContextLink(ID, typeOfID, conID)

**Foreign key ID references** Work (wID), Expression (eID)

**Foreign key conID references** Context (conID)

#### GrpOneAndTwoLink

The table GrpOneAndTwoLink appears in all the three views.

Work view	GrpOneAndTwoLink ( <u>wID</u> , <u>grpTwoID</u> , <u>typeOfIDtwo</u> , <u>relation</u> )
Expression view	GrpOneAndTwoLink ( <u>eID</u> , <u>grpTwoID</u> , <u>typeOfIDtwo</u> , <u>relation</u> )
Manifestation view	GrpOneAndTwoLink ( <u>mID</u> , <u>grpTwoID</u> , <u>typeOfIDtwo</u> , <u>relation</u> )

The attributes wID, eID, and mID of GrpOneAndTwoLink are merged, and the attributes grpOneID and typeOfIDone are derived.

#### GrpOneAndTwoLink (grpOneID, typeOfIDone, grpTwoID, typeOfIDtwo, relation)

**Foreign key grpOneID reference** Work (wID), Expression (eID), Manifestation (mID)

**Foreign key grpTwoID reference** Person (personID), CorporateBody (crpID)

#### GrpOneEntLink

Table GrpOneEntLink appears in all three views.

Work view	GrpOneEntLink ( <u>wID</u> , <u>IDto</u> , <u>typeOfIDto</u> , <u>relation</u> )
Expression view	GrpOneEntLink ( <u>eID</u> , <u>IDto</u> , <u>typeOfIDto</u> , <u>relation</u> )
Manifestation view	GrpOneEntLink ( <u>mID</u> , <u>IDto</u> , <u>typeOfIDto</u> , <u>relation</u> )

The attributes wID, eID, and mID are merged, and the attributes IDfrom and typeOfIDfrom are derived.

<b>GrpOneEntLink</b> ( <u>IDfrom</u> , typeOfIDfrom, IDto, typeOfIDto, relation) <b>Foreign key</b> IDfrom <b>reference</b> Work (wID), Expression (eID), Manifestation (mID) <b>Foreign key</b> IDto <b>reference</b> Person (personID), CorporateBody (crpID)
---

**IntAudienceLink**

This entity is linked to both Work and Expression.

Work view	IntAudienceLink ( <u>wID</u> , <u>audiencelD</u> )
Expression view	IntAudienceLink ( <u>eID</u> , <u>audiencelD</u> )

The attributes wID and eID are merged into the attribute ID, and the attribute typeOfID is assigned.

<b>IntAudienceLink</b> ( <u>ID</u> , typeOfID, <u>audiencelD</u> ) <b>Foreign key</b> ID <b>reference</b> Work (wID), Expression (eID) <b>Foreign key</b> audiencelD <b>reference</b> IntAudience (audiencelD)
--

**MediumOfPerfLink**

This entity is linked to both Work and Expression.

Work view	MediumOfPerfLink ( <u>wID</u> , <u>medOfPerfID</u> , number)
Expression view	MediumOfPerfLink ( <u>eID</u> , <u>medOfPerfID</u> , number)

The attributes wID and eID are merged and we assign the attributes ID and typeOfID.

<b>MediumOfPerfLink</b> ( <u>ID</u> , typeOfID, <u>medOfPerfID</u> , number) <b>Foreign key</b> ID <b>reference</b> Work (wID), Expression (eID) <b>Foreign key</b> medOfPerfID <b>reference</b> MediumOfPerformance (medOfPerfID)
--

**OtherDistChar**

This entity relates to both Work and Expression

Work view	OtherDistChar ( <u>charID</u> , wID, distChar)
Expression view	OtherDistChar ( <u>charID</u> , eID, distChar)

The attributes wID and eID are merged and the attributes ID, and typeOfID is assigned

<b>OtherDistChar</b> ( <u>charID</u> , ID, typeOfID, distChar) <b>Foreign key</b> ID <b>reference</b> Work (wID), Expression (eID)
---

## TitleLink

This entity appears in all three views

Work view	TitleLink ( <u>wID</u> , <u>titleID</u> , typeOfTitle)
Expression view	TitleLink ( <u>eID</u> , <u>titleID</u> , typeOfTitle)
Manifestation view	TitleLink ( <u>mID</u> , <u>titleID</u> , typeOfTitle)

The attributes wID, eID, and mID are merged

<b>TitleLink</b> ( <u>ID</u> , <u>typeOfID</u> , <u>titleID</u> , typeOfTitle) <b>Foreign key ID reference</b> Work (wID), Expression (eID), Manifestation (mID) <b>Foreign key titleID reference</b> Title (titleID)
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## UseResLink

This entity appears in both Expression and Manifestation view

Expression view	UseResLink ( <u>eID</u> , <u>restrID</u> )
Manifestation view	UseResLink ( <u>mID</u> , <u>restrID</u> )

The attributes eID and mID are merged

<b>UseResLink</b> ( <u>ID</u> , <u>typeOfID</u> , <u>restrID</u> ) <b>Foreign key ID reference</b> Expression (eID), Manifestation (mID) <b>Foreign key restrID reference</b> UseRestrictions (restrID)
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## 10.4 Appendix D: Data dictionaries for the two logical models.

### Data dictionary for FRBR

Table 1: **AcqLink**

Link between the tables AcquisitionSource and Manifestation.

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Number	Integer	foreign key from Manifestation	y	n	y
<u>acqID</u>	Number	Integer	foreign key from AcquisitionSource	y	n	y

Table 2: **AcquisitionSource**

Paragraph in FRBR: **4.4.15**

Source for Acquisition

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>acqID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
source	Text	50	publisher, distributor from which the manifestation may be acquired...	y	n	n

Table 3: **Availability**

Paragraph in FRBR: **4.4.16**

Availability of a manifestation

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>availID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
condition	Text	80	term of availability e.g. free to members, price, etc.	y	n	n

Table 4: **AvailLink**

Link between the tables Availability and Manifestation

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Number	Integer	foreign key Manifestation	y	n	y
<u>availID</u>	Number	Integer	foreign key Availability	y	n	y
fromDate	Text	15	a single date	n	y	n

toDate	Text	15	a single date	n	y	n
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Table 5: **Context** Paragraph in FRBR: 4.4.7, and 4.3.10

Context of a work or an expression

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>conID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
context	Text	50	context for work or expression	y	n	n

Table 6: **ContextLink**

Links a context to a work or an expression

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1 char	W, E	y	n	y
<u>conID</u>	Number		foreign key	y	n	y

Table 7: **ControlNumber** Paragraph in FRBR: 4.4.14

Control number of manifestations

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>number</u>	Text	50	any control number	y	n	y
<u>mID</u>	Number	Integer	foreign key	y	n	y
typeOfNum	Text	50	ISBN, ISSN, NB, BIBSYS, etc.	y	n	n

Table 8: **CorporateBody** Paragraph in FRBR: 4.7.2 – 4.7.5

Contains data for corporate body

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>crpID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
number	Number	Integer	numerical designation	n	y	n
place	Text	50	city, town, etc.	n	y	n
dateCrp	Text	50	single date or range of dates	n	y	n
other	Memo		binary large object (BLOB)	n	y	n

Table 9: **CriticalResponse**

Paragraph in FRBR: **4.3.11**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>respID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
eID	Number	Integer	foreign key	n	n	n
criticism	Memo		BLOB	n	n	n

Table 10: **CrpBodyName**

Paragraph in FRBR: **4.7.1**

Contains the name(s) of the corporate body

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>crpNameID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
name	Text	100	word, phrase, character, etc.	y	n	n
subdivision	Text	100	word, phrase, character, etc.	n	y	n

Table 11: **CrpNameLink**

Links the name of the corporate body to the data of the corporate body

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>crpID</u>	Number	Integer	foreign key	y	n	y
<u>crpNameID</u>	Number	Integer	foreign key	y	n	y
fromDate	Text	15	single date or range of dates	n	y	n
toDate	Text	15	single date or range of dates	n	y	n

typeOfName	Text	30	for variant names	n	y	n
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Table 12: **Expression** Paragraph in FRBR: **4.3.3, and 4.3.6 – 4.3.9, and 4.3.13 – 4.3.16**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
eID	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
eDate	Text	25	single date or range of dates	n	y	y
extent	Text	50	quantification of intellectual content	n	y	n
expand	Text	l	y, n	n	y	n
revise	Text	l	y, n	n	y	n
abstract	Memo		BLOB	n	y	n
sequencingPattern	Text	50	e.g. Volume..., number...	n	y	n
regularity	Text	l	r, i	n	y	n
frequency	Text	50	weekly, annually, etc.	n	y	n
typeOfScore	Text	50	e.g. short score, full score, etc.	n	y	n
otherInfo	Text	250	notes	n	y	n
wID	Number	Integer	foreign key. The relationship IsRealizedThrough is given here	y	n	y

Table 13: **Form** Paragraph in FRBR: **4.3.2**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>formID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
form	Text	50	musical sound, spoken word...	y	n	n

Table 14: **FormLink**

Links the form data to an expression

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>elID</u>	Number	Integer	foreign key	y	n	y
<u>formID</u>	Number	Integer	foreign key	y	n	y

Table 15: **FormOfCarrier**

Paragraph in FRBR: 4.4.9

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>carrierID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
formOfCarrier	Text	50	cassette, microfilm...	y	n	n

Table 16: **FrmOfCarManifLink**

Links the form of carrier to a manifestation

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Number	Integer	foreign key	y	n	y
<u>carrierID</u>	Number	Integer	foreign key	y	n	y

Table 17: **GrpOneAndTwoLink**

Links the entities of group Two and the entities of group One, and gives the relationship between the entities

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>grpOneID</u>	Number	Integer	foreign key group one object	y	n	y
<u>typeOfIDone</u>	Text	1	W, E, M	y	n	y
<u>grpTwoID</u>	Number	Integer	foreign key group two object	y	n	y
<u>typeOfIDtwo</u>	Text	1	C(orporate Body), P(erson)	y	n	y
<u>relation</u>	Text	50	IsCreatedBy, IsRealizedBy, IsProducedBy, etc. Subject relationships between Work and group Two would also be placed in this table.	y	n	y

Table 18: **GrpOneEntLink**

Links the entities of group One and gives the relationships between them

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>IDfrom</u>	Number	Integer	foreign key	y	n	y
<u>typeOfIDfrom</u>	Text	1	W, E, M	y	n	y
<u>IDto</u>	Number	Integer	foreign key	y	n	y
<u>typeOfIDto</u>	Text	1	W, E, M	y	n	y
<u>relation</u>	Text	50	IsEmbodiedIn, IsPartOf, etc. The subject relationships between Work and group One entities would also be placed in this table	y	n	y

Table 19: **IntAudience** Paragraph in FRBR: 4.2.6, and ??Expression

Intended audience for an expression lacks in FRBR. The intended audience is not necessarily the same for all the expressions of a work.

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>audienceID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
groupName	Text	50	children, adults, etc.	y	n	n

Table 20: **IntAudienceLink**

This table links the information about intended audience to a work or an expression.

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1	W, E	y	n	y
<u>audienceID</u>	Number	Integer	foreign key	y	n	y

Table 21: **Language**

Paragraph in FRBR: 4.3.4

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>eID</u>	Number	Integer	foreign key	y	n	y
<u>language</u>	Text	3	ISO language list	y	n	y

Table 22: **Manifestation**Paragraph in FRBR: **4.4**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
responsible	Text	250	responsibility designations that appear in the document	n	y	n
edition	Text	50	edition statements that appear in the document	n	y	n
dateOfPubl	Text	15	single date or range of dates	n	y	n
extOfCarrier	Text	60	number of physical units	n	y	n
dimOfCarr	Text	50	height, width, depth, or diameter	n	y	n
captureMode	Text	50	e.g. analogue, digital, etc.	n	y	n
typeFace	Text	10	style of type	n	y	n
typeSize	Text	10	size of the characters	n	y	n
publStatus	Text	10	publication status (serials)	n	y	n
playingSpeed	Text	50	e.g. 33 1/3 rpm	n	y	n
tapeConfig	Text	50	number of tracks on sound recording	n	y	n
specReprodChar	Text	50	special reproduction characteristic	n	y	n

Table 23: **MediumOfPerformance**Paragraph in FRBR: **4.2.8, and 4.3.17**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>medOfPerfID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
instrument	Text	50	may also be vocal medium (alto, etc.)	y	n	n

Table 24: **MediumOfPerfLink**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1	W, E	y	n	y
<u>medOfPerID</u>	Number	Integer	foreign key	y	n	y
number	Number	Integer	how many of one instrument	n	n	n

Table 25: **NumberDesignation** Paragraph in FRBR: **4.2.9**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>numID</u>	Text	50	e.g. op. 23 nr 11	y	n	y
<u>wID</u>	Number	Integer	foreign key	y	n	y
<u>designation</u>	Text	50	e.g. opus	y	n	y

Table 26: **OtherDistChar** Paragraph in FRBR: **4.2.4, and 4.3.5**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>charID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
ID	Number	Integer	foreign key from Work or Expression	y	n	n
<u>typeOfID</u>	Text	1	W, E	y	n	n
distChar	Text	50	distinguishing characteristic	y	n	n

Table 27: **Person** Paragraph in FRBR: **4.6.2, and 4.6.4**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>personID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
bornDate	Text	15	single date	n	y	n
deadDate	Text	15	single date	n	y	n
other	Text	250	notes	n	y	n

Table 28: **PersonName** Paragraph in FRBR: **4.6.1**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>pNameID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
name	Text	70		y	n	n

Table 29: **PersonNameLink**

Links the name information to the data of a person

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>personID</u>	Number	Integer	foreign key	y	n	y
<u>pNameID</u>	Number	Integer	foreign key	y	n	y
fromDate	Text	15	this could be included in the primary key, but since I do not have any data for this attribute it is left out.	y	y	n
toDate	Text	15		n	y	n
typeOfName	Text	50	pseudonym, maiden name, ... (authorized)	n	y	n

Table 30: **PersonTitle**

Paragraph in FRBR: 4.6.3

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>pTitleID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
pTitle	Text	50		y	n	n

Table 31: **PersonTitleLink**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>personID</u>	Number	Integer	foreign key	y	n	y
<u>pTitleID</u>	Number	Integer	foreign key	y	n	y

fromDate	Text	15		y	y	n
toDate	Text	15		n	y	n

Table 32: **PhysicalMedium**

Paragraph in FRBR: 4.4.1.1

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>physMediumID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
physicalMedium	Text	50	metal, plastic...	y	n	n

Table 33: **PhysMediumLink**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Number	Integer	foreign key	y	n	y
<u>physMediumID</u>	Number	Integer	foreign key	y	n	y

Table 34: **PlaceOfPublication**

Paragraph in FRBR: 4.4.4

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>placeID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
placeName	Text	50		y	n	y

Table 35: **PlacePubLink**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mID</u>	Number	Integer	foreign key	y	n	y
<u>placeID</u>	Number	Integer	foreign key	y	n	y

Table 36: **SeriesLink**

This table links the Manifestation record of a document that is part of a series with the Manifestation record of the series.

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>mIDfrom</u>	Number	Integer	foreign key Manifestation (part of series)	y	n	y
<u>mIDto</u>	Number	Integer	foreign key Manifestation (series)	y	n	y
partNumber	Text	35	volume/issue or date	n	y	n

Table 37: **Subject** Paragraph in FRBR: 4.8 – 4.11

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>subjectID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
term	Text	50	e.g. Dewey number	y	n	y
typeOfTerm	Text	1	C, O, E, P (Concept, Object, Event, Place)	y	n	n

Table 38: **SubjectLink**

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>wID</u>	Number	Integer	foreign key	y	n	y
<u>subjectID</u>	Number	Integer	foreign key	y	n	y

Table 39: **Title** Paragraph in FRBR: 4.2.1, and 4.3.1, and 4.4.1

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>titleID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
title	Text	250		y	n	y
subtitle	Text	250		n	y	n

Table 40: **TitleLink**

This table links the titles to the bibliographic entities Work, Expression, and Manifestation

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
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<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1	W, E, M	y	n	y
<u>titleID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfTitle</u>	Text	50	main, part, etc.	n	y	n

Table 41: **UseResLink**

<b>attribute</b>	<b>data type</b>	<b>field size</b>	<b>domain and description</b>	<b>mandatory</b>	<b>may be empty</b>	<b>indexed</b>
<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1	E, M	y	n	y
<u>restrID</u>	Number	Integer	foreign key	y	n	y

Table 42: **UseRestrictions**

Paragraph in FRBR: **4.3.12, and 4.4.16, and 4.5.9**

<b>attribute</b>	<b>data type</b>	<b>field size</b>	<b>domain and description</b>	<b>mandatory</b>	<b>may be empty</b>	<b>indexed</b>
<u>restrID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
limitation	Text	50	e.g. copyright	y	n	n

Table 43: **Work**

Paragraph in FRBR: **4.2.2 – 4.2.5**

<b>attribute</b>	<b>data type</b>	<b>field size</b>	<b>domain and description</b>	<b>mandatory</b>	<b>may be empty</b>	<b>indexed</b>
<u>wID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
form	Text	50	novel, play, etc.	n	y	n
wDate	Text	25	single date, or range of dates	n	y	n
typeOfWork	Text	20	fiction, non-fiction, series, music, image, sound-recording, video,...	n	y	n
otherInfo	Text	250	notes	n	y	n

## Data dictionary for the expression-prioritized model

Since many of the tables are identical to the tables of the FRBR database, only the tables that differ from the FRBR model are listed here. The numbers assigned to the tables refer to the numbers in the FRBR data dictionary.

Table 12: **Expression**

attribute	data type	length	domain	mandatory	may be empty	indexed
eID	Auto-number	Integer	auto number assigned by the DBMS	y	n	y
responsible	Text	250	responsible for expression; assignments that appear in a document and are related to the intellectual content	n	y	n
edition	Text	50	statements that appear in a document and are related to the intellectual content	n	y	n
eDate	Text	25	single date or range of dates	n	y	y
extent	Text	50	quantification of the intellectual content	n	y	n
expand	Text	1	y, n	n	y	n
revise	Text	1	y, n	n	y	n
abstract	Text		BLOB	n	y	n
sequencingPattern	Text	50	e.g. Volume ..., number...	n	y	n

regularity	Text	1	r, i	n	y	n
frequency	Text	50	weekly, quarterly, etc.	n	y	n
typeOfScore	Text	50	short score, full score, etc.	n	y	y
otherInfo	Text	250	notes	n	y	n

Table 18: **GrpOneEntLink**

This table links the bibliographic entities, Work, Expression, and Manifestation

attribute	data type	length	domain	mandatory	may be empty	indexed
<u>IDfrom</u>	Number	Integer	foreign key	y	n	y
<u>typeOfIDfrom</u>	Text	1	W, E, M	y	n	y
<u>IDto</u>	Number	Integer	foreign key	n	n	y
<u>typeOfIDto</u>	Text	1	W, E, M	n	n	y
<u>relation</u>	Text	50	IsExpressedIn, IsFixedIn, IsPartOf etc. Subject relations between Work and group One entities.	n	n	y

Table 22: **Manifestation**

attribute	data type	length	domain	mandatory	may be empty	indexed
<u>mID</u>	Auto-number	Long integer	auto number assigned by the DBMS	y	n	y
responsible	Text	250	restricted to statements related to manifestation (i.e. formatting of a Text, typeface, page-layout, publisher)	n	y	n
edition	Text	50	statements relating to difference in form of carrier	n	y	n
dateOfPubl	Text	15	single date or range of dates	n	y	y
extOfCarrier	Text	60	number of physical units	n	y	n
dimOfCarr	Text	50	height, width, depth, or diameter.	n	y	n
captureMode	Text	50	e.g. analogue, digital, etc.	n	y	n
typeFace	Text	10	style of type, e.g. Times New Roman	n	y	n
typeSize	Text	10	size of the characters	n	y	n

publStatus	Text	10	publication status (serials)	n	y	n
playingSpeed	Text	50	e.g. 33 1/3 rpm	n	y	n
tapeConfig	Text	50	number of tracks	n	y	n
specReprodChar	Text	50	special reproduction characteristic	n	y	n

Table 36: **SeriesLink**

This table links the Expression record of a document that is part of a series with the Expression record of the series.

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>eIDfrom</u>	Number	Integer	foreign key Expression (part of series)	y	n	y
<u>eIDto</u>	Number	Integer	foreign key Expression (series)	y	n	y
partNumber	Text	35	number designating the sequential position of the expression within the series	n	y	n

Table 40: **TitleLink**

This table links the titles to the bibliographic entities Work and Expression

attribute	data type	field size	domain and description	mandatory	may be empty	indexed
<u>ID</u>	Number	Integer	foreign key	y	n	y
<u>typeOfID</u>	Text	1	W, E	y	n	y
<u>titleID</u>	Number	Integer	foreign key	y	n	y
typeOfTitle	Text	50	main, part, etc.	n	y	n