

The Work Entity on FRBR: an Object Oriented Approach

Abstract

We discuss some criticism that has received FRBR concerning the entity *Work*. The main problem refers to the lack in FRBR of a conceptualization for attributes of *Work*. Both FRBR models, FRBR_{er} and FRBR_{oo} are analyzed considering the way attributes of work are treated in the first, and the subclassification of class F1 Work in the second. In the first case the analysis shows that FRBR_{er}, although it presents a new conception of main bibliographic entities, has the weakness of been closely dependent from MARC format when treating other entities. In the second, the dependency of multiple inheritance, derived from the model which FRBR_{oo} tries to integrate, CRM, and an abstract conception of object modelling, which neglected the concrete uses of bibliographic entities, leads to an abstruse model, which has proved to be difficult to understand, implement and use. The proposed alternative, which is part of an object oriented model, is to conceive concrete bibliographic entities as subclasses of abstract classes for WEMI entities.

Introduction

As Computer Science's community knows well, there is not a unique idea of *object paradigm*. The question of inheritance in particular has three different approaches: single inheritance, as in Simula, Smalltalk, Java, etc, multiple inheritance, as in C++, and no inheritance at all, as in prototype-based programming language as Self. For this article we have taken the point of view of object-orientation paradigm with simple inheritance and the use of design patterns¹.

It should be noticed that many issues concerning multiple inheritance can be solved in any model based on single inheritance by using the technique called *delegation*; this is not a way to "patch up" the model because of its lack of multiple inheritance. Instead, delegation is a way to analyze the domain and discover new concepts which remain hidden by a simply taxonomic approach. As we will see, these new aspects that arise from analysis are not just implementation issues needed to solve technical questions but new abstractions that may become part of our understanding of the domain, i.e., the bibliographic universe. Consequently, the model we present is not an implementation proposal, nor a search of abstractions to explain some traits of the bibliographic universe, but both of them.

As programming history demonstrates, *a priori* designs should be contrasted with reality. Flow charts, UML diagrams, ER schemes, neither of them ensure the sustainability of a model that has not been observed in a real implementation and tested by domain experts. The cycles of the software are always iterative and circular: the observation and testing can lead to a modification of the model, which in turn can cause changes in the implementation.

Bibliographic catalogs are no longer mere collections of data: the information they carry travels beyond their original boundaries to many other areas: one could say that almost everything in the Web (sites, blogs, tweets, etc) is a bibliographic entity. This new

realities lead us to model the bibliographic universe with a technology that provides ways of conceiving our domain dynamically. Theoretical analysis could entail changes in models, not at the requirements level, but at the conceptual level, as a consequence of the mentioned characteristics of software life cycle. In terms of object orientation this means thinking less about entities, attributes, data and more on interaction ways and processes, i.e. behaviors.

It is not possible in the space of this article to address all FRBR issues in the light of object technology, so we have selected the the problems depicted in the Work entity and in their the attributes specified in FRBR_{er}.

To simplify this exposition, we will use only literary and musical works as examples. In the graphics we will use very simple class diagrams, detailed in **Figure 1**. Empty arrows mean an inheritance relationship; full arrows a composition relationship; double arrows mean a one-to-many cardinality. Only if it is necessary for the exposition we will include class attributes in a text box within the box representing the class. These diagrams can be interpreted as an entity-relationship, although this is not the idea, taking into account that inheritance is just a special kind of relationship

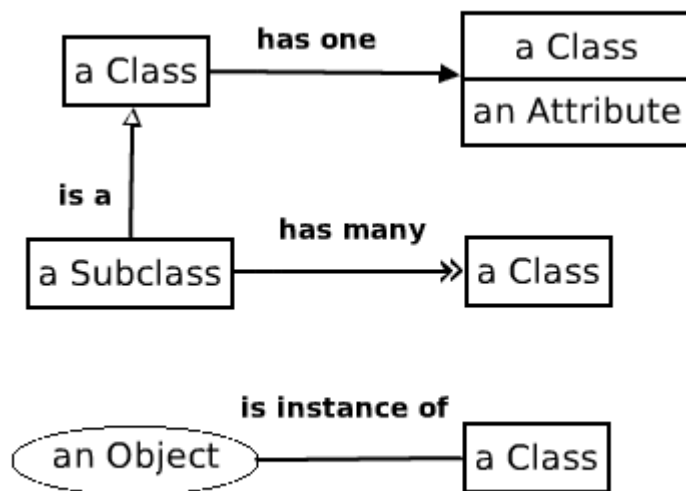


Figure 1

I The Work in FRBR_{er}

The first point to discuss, which has been mentioned sometimes in the specific literature, is the different levels of analysis with which are treated the main bibliographic entities (Work, Expression, Manifestation, and Item, WEMI from now) on one side and the attributes of each one of them on the other. We mentioned the case of names and time which, although they were originally conceived as attributes, claim to be reified as entities in their own right.

To illustrate this we will take some attributes of the *Work* entity: *language*, *medium of performance*, *numeric designation*, and *key*. The first thing an expert on cataloging systems would immediately notice is that these attributes seem to refer to certain MARC fields.² This may indicate IFLA's will to keep backward compatibility with the most widely used bibliographic format.³ But the very mentioned inadequacy of a record format conceived in the 70's with the present bibliographic realities^{4 5} is one of the reasons that led to FRBR_{er} model, whereas the entities *Work*, *Expression* and *Manifestation* imply a large redefinition of the ideas that led to that format. The attributes of these entities do not seem to be the result of a complete conceptual reconfiguration of the bibliographic universe, but only moving some MARC fields to the new model.

The first thing a software designer will notice is that if some of these attributes correspond to musical works—i.e. not all types of works, but some of them—these attributes should not be in the top level. They should be in a subclass of *Work*, say a class *Musical Work*. The same could be said about the *language* attribute, which only makes sense in a literary work, but not in a musical work.⁶

The cataloger would remark that the intention of a field for musical key is to form the main entry, because otherwise many classical instrumental works would have the same title.⁷ The designer then should respond whether the use of this attribute is not merely descriptive, but has an identification purpose, it should then form part of a general entity called *Identifier*, which in the case of musical works, would use the key of the piece, among others elements. The need to define identifiers for each WEMI entity has been reported,⁸ which in terms of FRBR_{er} would mean to considered identifiers as entities in their own right. In the case of music several elements come into play: not only the key but also the medium of performance, the identifiers assigned by musicologists (BWV, Koegel, etc.), the numbering set by composers and publishers as the Opus number, etc.: the right combination of these elements produces the *uniform title*. From the point of view of the programmer, the *uniform title* is a string of characters to scan and parse if he wants to identify its different constituent elements, each with different semantics. While this way of constructing a uniform title is enough to fulfill the function of identifying, it prevents their use for other purposes, because of the potential semantic loss, and therefore, difficult retrieval. Any attempt to sort or group pieces of music by opus number, by their key or by their instrumentations—which for the purposes of grouping would be very important for the usage of the obtained documents, either for their execution as for their study—will depend on the strict compliance with the rule applied by the cataloger and the effectiveness of the parsing algorithm. As we remark above, MARC format allows to record these “strings” also in their own fields. But now another problem arises: data could be duplicated, or could be present at one side while absent in the other. Being aware that this discussion goes beyond the boundaries of this article, we can not fail to mention the possibility of building the uniform title automatically from these fields. That way data is not duplicated and both requirements, identifying and retrieving, can be fulfilled. This way of automatic building of titles was exposed in other article⁹, when discussing key titles of serials. This approach would meet the need expressed above in relation to the greater importance given to the behavior with respect to the data.

Another criticism that FRBR_{er} has received is its high level of abstraction, making it difficult to understand and use. Not only because of the inherent difficulties of any abstraction but by the absence in the model of concrete entities traditionally referred by

both librarians and users.¹⁰ Entities such as Edition, Translation, Novel, Performance, Sound Recording, Monograph, Score, Serial, Map, Movie, etc., are concrete bibliographic entities, each with its own distinctive features, which can only be differentiated by the content of some attributes such as *form* (of the *Work*, of the *Expression*, of the *Manifestation*).

The high level of abstraction is a good news if we intend to conceive the bibliographic universe in a scientific way. But once defined the main entities with the highest degree of abstraction FRBR_{er} set specific attributes immediately. And here is the conceptual gap: as an abstract entity, the *Work* has many diverse specific instances: a novel, an opera, a film, a manual, an electronic document, etc. These "types" of work have little in common and many things that differentiate them, whether we see them as entities with attributes, i.e. different data types that must be taken into account in the description, as if we see them as objects with certain behavior: to which other entities are related, how are these relationships, and so on

However, much can be said of a particular work, say, Bach's *Goldberg Variations*: it is in G major, it was designed to be played on a double manual harpsichord, it was assigned the identifier BWV 988, etc. But we could not say similar things about a novel, say, *Rayuela (Hopscotch)*, by Julio Cortázar. It makes no sense to say that it is in a key, but instead we can say that is written in Spanish, something which we can not say about Bach's work.

Does it make sense that attributes such as *language* and *key* are attributes of the *Work* entity? Shouldn't be them attributes of more specialized entities that we could call *Musical Work* and *Literary Work*? Following the point of view of object orientation, we are not concerned in establishing what are the attributes of a given entity, but what is its behavior in the corresponding domain, which is determined by the interactions of this entity with other entities in this domain (the bibliographic universe) and with users (human species). Since the core of object technology is the object-message pair, the question we should make is "what messages should send and receive the object that represents the domain entity?". In the examples given, the answer would be that we can send the messages "what's your name?" or "who is your author?" to any work, but we can only send the message "in which language is written?" to certain works. Another kind of work, the musical work, should know how to answer the message "on what instrument is played?". This different "knowledge" of each objects defines different classes for each different behaviour. To the claim for the lack of a *type* attribute¹¹ or the lack of subtyping¹² we respond that better to set a type, which forces us to think that the *Goldberg Variations* is a work of type 'music' (but also of type 'variation' , of type 'keyboard music' , etc.) is to use the inheritance mechanism and say it is an object of class *Musical Work*, a subclass of the *Work* class. (Figure 2)

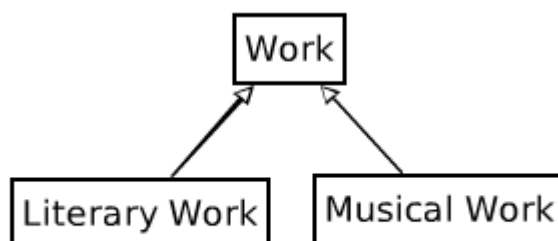


Figure 2

The same argument applies to the *Expression* and *Manifestation* entities; a translation, an augmented edition, a musical score, a musical performance, a theater play—all of them are expressions, but of very different kinds, with very different behaviors. Similarly, a publication print, an edition of compact discs, are all manifestations, each with its particular characteristics. If we define each of these entities as subclasses of *Expression* and *Manifestation* we're not talking only about abstractions, as these abstractions are now the matrix to produce concrete “things”.

The issue that has generated more debate is the boundary between *Work* and *Expression* entities. As arises from these controversies^{13 14}, this boundary can not be established universally as it is subject to criteria which depend on different cultural traditions and different cataloging practices.

Perhaps the best example is that of translations, and within them, translations of poetry. The objections from literary criticism that can be made considering the fact that a translated poem allows us to access the original, and not rather a new work derived from it, can lead us to an endless debate. But we need not wait for the end of the debate to get a practical solution. It is not necessary to state that the sameness between, say, a chemistry manual in English and its Spanish translation is similar to that between the original version of *C'est la vie*, a multilingual sonnet by Antoine Cassar, and its Spanish translation^{15 16}, or that between two performances of a classic musical piece and two versions of a jazz standard. Saying that two expressions are realizations of the same work says nothing about its reception modes, nor about critical or aesthetic stances: an expression can realize a work in an almost identical way as another, or can express it in a way that we can hardly recognize the original work: it does not change the fact of being expressions of that work. The difference must be given by another feature, and the division of FRBR Group 1 entities into sub-entities is the first step to sharpen the differences and particularities of each concrete entity. If both a translation and an augmented edition are expressions of works, it is clear that the way they realize the work is very different. The existence of specific classes called *Translation* and *Edition* ensures that these differences are represented in the model. Thus, a translation will never pretend something different to convey the same semantic content as the original expression, a pretension that could be achieved or not. An edition—a new edition, other than the original—always intends to be a kind of modification, whether an enlargement or a reduction, of the original expression.

Perhaps this criticism of the attributes of the main FRBR entities does not take into account that the model is not an implementation proposal. A programmer should not move the FRBR scheme as it is to a relational database defining a table *Works* with fields for *medium of performance*, *key*, *language*, etc. It has been said many times that FRBR is not a data model^{17 18} (although it has been referred to as data model by other scholars¹⁹). Indeed, FRBR is about requirements that must be met, but the lack of conceptualization of what FRBR sees as attributes, of which we only gave a few examples, does not let another way to the programmer.

Figure 3 shows a class diagram in which we place only a few examples of concrete classes.

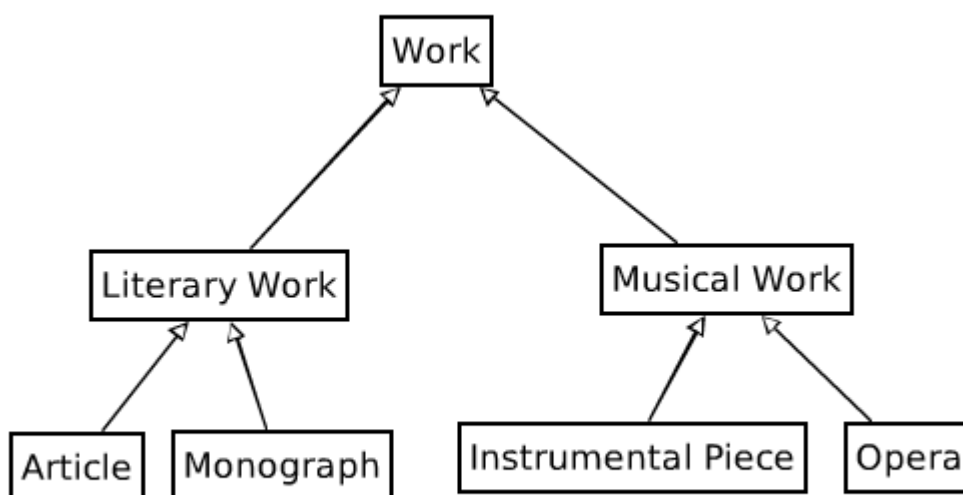


Figure 3

We are aware that there is no firmly established taxonomy to locate traditional bibliographic entities as Monograph, Article, Instrumental piece or Opera, as has been repeatedly said.^{20 21} This applies to the issue of the so-called documentary types and their relationship with information carriers, which we have addressed in other article.²²

II The Work in FRBR_{oo}

The object-oriented version of FRBR, known as FRBR_{oo}, has had much less diffusion than the original FRBR_{er}, and is far from being understood, even less accepted, by the community of librarians. For this reason, we need to do a quick overview of some of its central aspects.

FRBR_{oo} is “intended to capture formal ontology and represent the underlying semantics of bibliographic information and to facilitate the integration, mediation, and interchange of bibliographic and museum information”²³. It emerged as an attempt to align with the CIDOC CRM model for museum documentation, so that its objectives are: “Expressing the IFLA FRBR model with the concepts, tools, mechanisms, and notation conventions provided by the CIDOC CRM and aligning (possibly even merging) the two object-oriented models thus obtained.”²⁴

FRBR_{oo} defines the *F1 Work* class, an equivalent to FRBR_{er} *Work*, as a subclass of CRM’s *E28 Conceptual Object*, and from there defines the subclasses according to structural features inherent to the different types of work. A work may be a *F14 Individual Work* if “it was realised by one and only one self-contained expression, i.e., representing the concept works as express by precisely this expression, and that do not have other works as parts”, a *F17 Aggregation Work* if it’s a “selection and / or arrangement of expressions of other works,” a *F15 Complex Work* if it has “more than one work as members,” a *F16 Container Work* if it consists of “works whose essence is to enhance or add value to expressions from other works without altering them, by the selection, arrangement and/or addition of features of different form.” We can not dwell on other subclasses of *F1 Work* because that would extend this article too much.

It was mentioned²⁵ that every work has parts. It is clear that even a poem has parts—its verses; even the words of an aphorism or a haiku can be considered parts of the work.

What FRBR_{oo} attempts to distinguish is whether those parts are works or not. Since this quality of the parts of “being” works determines whether the major work is an individual work or a complex work, this must be set a priori according to the internal structure of the work. One of the classic examples of complex work, which FRBR_{oo} draws, is *The Ring of the Nibelungen*, Wagner’s tetralogy consisting of four operas that are usually played individually, but are part of a larger work that brings them together. A work like Bach’s *Mass in B minor* contains parts, like any mass, but none of these parts could be considered a work. From the point of view of the structure of the work, the very famous Bach’s *Aria on the G string* has not a different relationship with the work that contains it, the *Orchestral Suite No. 3* – than any other aria, gavotte or allemande from any baroque suite. However, the existence of recordings of the *Aria* without the rest of the *Suite*, of countless versions of the piece for different instruments with their corresponding recordings, etc., forms a network that has its center in something that, by strength of evidence, we might call *work*. This example shows that the characteristic of a work to have parts that are themselves works can not be defined taking into account the structure of the work. Even if possible, the classification to which we’ll arrive is dependent on historical and cultural conditions and may change in the future. Any typology that is based solely on the internal structure of works will necessarily be temporary.

The topic of the subclasses of F1 Work in FRBR_{oo}, far from being an implementation issue, inevitably leads us even beyond the conceptual level to the philosophical level. It is not possible in this article to go deeper on the definition of the work entity, an issue that has been much debated and is far from being solved.²⁶ For explanatory purposes, aware of a possible oversimplification of the issue, we can divide the ways of conceiving the work into two major groups. On the one hand, the sustancialist or structuralist definitions, which seek to define the work as it is in itself. FRBR_{er} and FRBR_{oo} definitions and most of the specific literature express this idea. On the other hand, the sociological definition, which conceives the work as a social fact.²⁷ There would be a third group that while considering the work as a social fact, does not forsake to define it by its intrinsic characteristics.²⁸

If we conceive the work as a social fact, we must regard the behavior of the work as the interactions it has with users who consume works, with institutions that provide works, with people who produce works, etc. The question of the *Aria on the G string* considered as a work can not be approached other than this way. Whether or not one agrees with the sociological view, it allows us to respect a guiding principle of cataloging, the *Principle of user convenience*: “Decisions taken in the making of descriptions should be made with the user in mind.”^{29 30} But even from a structuralist definition of work, like Svenonius’ (“The set of all documents sharing essentially the same information”), and considering that the work is the main object of user interest, precisely because the information it carries is what the user needs to obtain, we reach the same conclusion: it is necessary to think the work in terms of how it is used by their users.

Although there is little research in relation to FRBR entities and user criteria,³¹ it is clear that entities such as *Translation* or *Augmented Edition*, for example, have for users (and this should include other agents of the documentary process than readers, such as translators, editors, publishers, etc.) the role that FRBR has assigned to them: to be expressions of a work. Nobody reads a translated text thinking he is reading something completely different from the original work; no one believes he is reading exactly the

same work. The same could be said about musical performances or other classic examples of expressions. The reason is that the work-expression distinction does not only have to do with the structural characteristics of these entities, but with specific practices that all the agents involved in them are subject to.

Instead, FRBR_{oo} distinctions have no correlation with any practices of such agents. Differences can only be explained by the internal structure of works. Based on these distinctions we will never get entities such as opera, novel, symphony, etc.

If the objective is to define the works based on their behavior and keep the users' classification criteria, whatever it should be, the conclusion is that the full scheme of works in FRBR_{oo} is not very useful, although that's not true about the considerations that led to such a scheme. The distinction between works that consist in the selection of existing works, for example, is a very necessary distinction in terms of behavior from the perspective of the user.

While it is true that for many users it may be indifferent whether an individual work is inside a selection along with others or in its original manifestation, in the first case they have immediate access to other works (works by the same author, on the same topic, etc.) that could potentially be of their interest. Therefore, the circulation mode, the responsibility roles (editors, authors), the relationship of the work with its parts, shape not only different structures but different behaviors. What remains to be established is whether this valuable distinction must be defined by the class—that is, the “type” of work—or can be inferred from other features. By the conditions imposed by the production of sound recordings (vinyl, cassette, CD) a lot of musical works are embodied inside a *Container Work*. Considering these works as the same type of literary anthologies, for example (and that means they will be instances of the same class) prevents the definition on the class side of any particular feature of each of these two types of works, sound recordings and anthologies, because in both cases the class is the same. Returning to what we said at first, to distinguish literary works (in the broadest sense, works consisting of text in a given language) from musical works we would be forced to use multiple inheritance by adding to the previously shown diagram two classes: *Musical Work* and *Literary Work*.

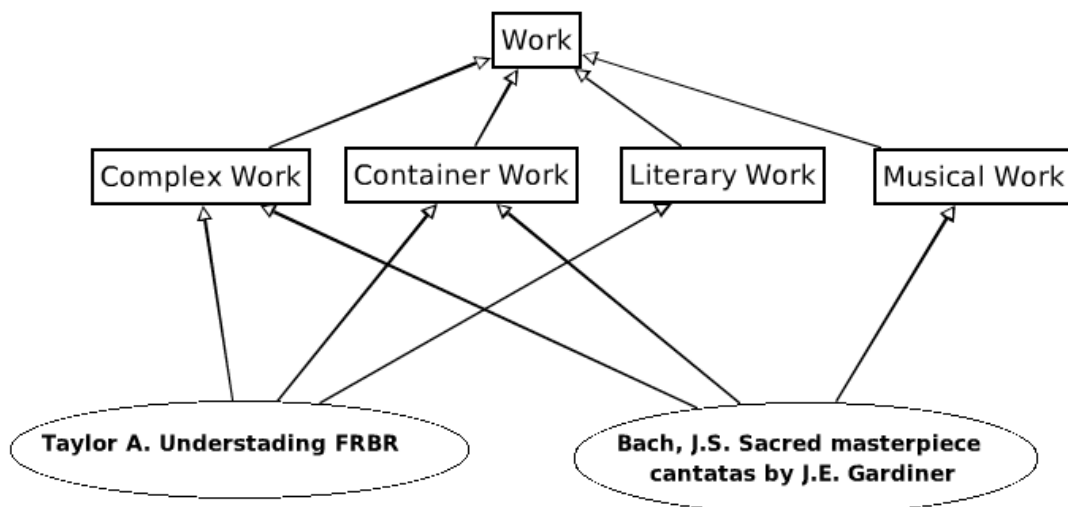


Figure 4

As seen in **Figure 4** the examples of work have also the characteristics of *Complex Work*, so each instance will inherit from three classes. But the aspect considered here (whether the work is musical or literary) is just one of many possible. From fairly simple examples we get a complicated scheme, but it may be complicated further.

The implementation of the conceptual model proposed by FRBR_{oo} using object design has resulted in a diagram that illustrates the problems for which multiple inheritance has received so much criticism. If more than one subclass of *Work* defines the same message, which of its superclasses must address a specific instance to respond it? If some of the subclasses of *Work* redefine a message of its superclass by adding a particular feature, which one should answer the specific instance?

If we take into account that any subclass of both *Complex Work* and *Musical Work* may in turn inherit from more than one class, the consequence of the application of this methodology will be an explosion of classes, resulting in an unwieldy scheme, very difficult to understand, that forces the programmer to permanently use forks or other techniques that do nothing but obscure the view, in itself unclear. In addition, many works are not exclusively literary or musical, as is the case of operas and songs, so the corresponding classes for this kind of works will inherit from both the new proposed classes. In the following section we will discuss the issue of mixed works.

As we said, all works have parts. If these parts can not be considered as works at the time of being cataloged, the cataloger will decide whether to record them or not. However, it should be noted that, in the case of musical works, the parts of the work—whether a particular culture considers them as works or not—generally coincide with the tracks of a sound recording and, consequently, with the resulting files when the recording is digitized, so differentiation of these parts has become a need that goes beyond traditional cataloging. It is the way to ensure the interoperability of a bibliographic system with other systems in which the track is a must. The proliferation of digital art products suggests that any part of a work can be transformed into a new work, which may imply that the part itself could acquire the status of work in the future.

Therefore, to establish the distinctions made by FRBR_{oo} concerning aggregates we do not need nothing but assure the *Work* class includes the behavior of having parts.³² Whether the work is individual or complex is indicated by the presence or absence of parts; whether the parts are works or not is indicated by the class to which each part belongs: some of them could be works, others could not.

III The Work in Opus

The model we depict here was presented in several occasions in which we addressed different issues concerning FRBR and the bibliographic universe seen through the object paradigm glasses. It is not only an implementation of the major thrusts of FRBR but an intend to address the conceptual dimensions arising from IFLA's models, which has left many of them without a complete solution. Titles, physical carrier, authorship³³, responsibility functions, names and serials^{34 35}, key titles, subjects, relationships with other works, geographic names, implementation matters³⁶, relationships among FRBR item, carrier and document, and technical issues concerning a "ferberizator" software³⁷ has been some of the subjects the model tries to address. In light of the criticism made up above of the two models analyzed considering the problem of the types of work we now present how this issue is treated in our model.

What would be the criterion for defining different subtypes of work, without complicating the model with multiple inheritance? In the examples given up to now there was an implicit concept that needs to be explicit and would seem to be related to the classification of carriers proposed by Helmer.³⁸ On the basis of thinking bibliographic entities not by their physical characteristics but by the experience of the work, Helmer presents a classification based on the senses used to access the works. We should have works accessed by sight and works that are accessed by ear. There are no works for smell and taste, at least with our current cultural notion of work, although there are works that are accessed by touch, usually written texts transcribed to Braille. But in most cases, if not all, we are dealing with different manifestations of literary works: the sense used changes, but not their main features, and for that reason they are interchangeable: any literary work can be transcribed to Braille. If we consider that many literary works came to writing after a long tradition of oral literature, and that twentieth-century technology has revived partially this practice of listening to texts, from the very first sound recordings to the audio-books, and, moreover, the products of visual arts are accessed by the eyes, as literary works do, there is no other option but to dismiss this proposal. Certainly, neither the creators nor the consumers nor the producers, nor the related institutions are grouped following the criterion of senses, but traditional cultural divisions instead as Literature, Music, Visual Arts, etc., which results from the combination of many factors, of which the sense used is just one of them.

We must add another problem: properly literary works—that is, those created with an aesthetic purpose—and scientific textual works, they all share certain basic traits: they are texts on a certain language, which conditions their physical carriers, and in part, the modes of distribution and reception. But in many other aspects they are different as they belong to very different cultural domains. Besides, literary works share the aesthetic function with art works. But this distinction is not exclusive to textual works. There are also sound and musical recordings produced with scientific purposes rather than aesthetic.

Considerations about the “types” of work lead us directly to the problem of documentary types, an issue that has generated much discussion and about which nothing is clearly established yet.^{39 40} The categories of pure content proposed by Martha Yee^{41 42} seem better adapted to our cultural practices. The categories she proposed are: music (either musical notation or actual sound), text, still image, moving image, spatial data, three-dimensional objects, numeric data, computer programs. The categories of work given by Delsey⁴³ have enough coincidence with Yee’s, dividing the works into literary, musical, graphic, three-dimensional mapping, audio, data and computer programs. The criterion behind that makes sense of these classifications is that a work can not move from one category to another without becoming a new work, the same approach of Helmer’s General Experience Designator. But that does not conform to reality: a recited literary work or a recorded recitation are still literary works and the same can be said of a literary work transcribed into Braille. They do not result in a different work when the category of content has changed.

Let’s consider these categories as purely pragmatic and unscientific, and try to design an object model from them. The result is shown in **Figure 5**. For the purpose of the exposition only a few of these types were considered. Some concrete subclasses were included to facilitate the understanding of the scheme. The goal, as stated above, is to

set a consistent classification scheme and the modelling of specific entities according to the types established by common usage.

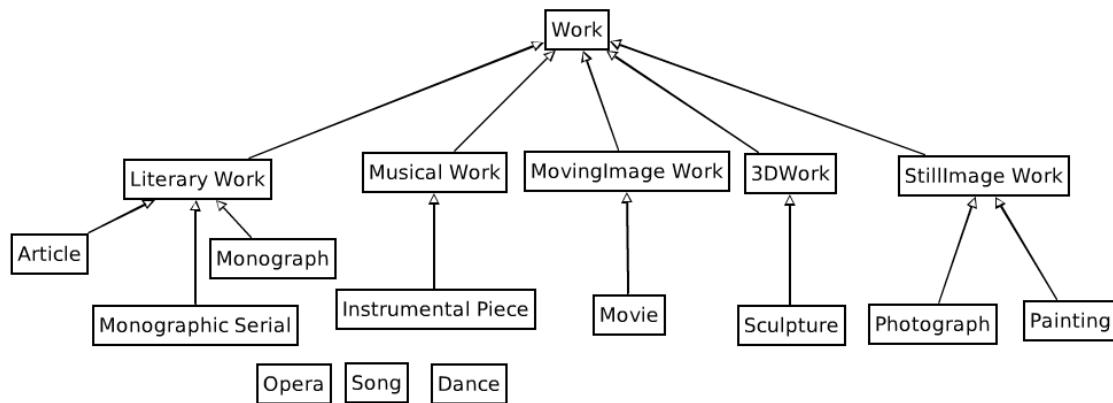


Figure 5

The figure shows that some of these entities have no place in the scheme, as they are mixed works as operas, songs and dance. Both Yee and Delsey include the category *mixed work*. Actually, any combination of the basic categories is conceivable: performances and installation art usually consist of combinations of more than one. We have seen that multiple inheritance would be a futile solution, and this case illustrates the problem: all combinations are possible, specific classes can inherit from all basic types, producing an unreadable diagram and a model that is very difficult to implement.

Since Yee's proposal is not a classification of works but a classification of contents, we must leave the *Work* entity and go to the *Expression*, which is defined by the content. From the point of view of LIS, *Work* and *Expression* are operational abstractions; they are useful as theoretical constructs, but, as with any abstraction, they lose in the process of abstraction part of their total reality. Both from the standpoint of the sender (the creator or producer of works) such as the receiver (the user), the WEMI entities form a unique reality: a composer produces a cultural object that we call musical work, which then can only be realized as a musical expression (a performance or a score), and if recorded it will be embodied necessarily on a musical manifestation (a edition of CDs) to be listened to by the obtention of a musical item (an individual CD). But a CD is not always a musical manifestation, as it can embody other kinds of expressions, such as literary works in the form of text files, files with images, movies, numerical data, software, tc. What defines the membership of the work to the music field is not the work nor the manifestation, nor the item, but the expression. A musical performance can not be nothing else but musical: it is the specific content of a particular expression that defines the type of the work. It is correct to consider that if the text and the dramatic action of *The Ring of the Nibelungs* is embodied in a book, the work has ceased to be a mixed work to become a literary work: it is not a feature of the work that has changed but the way it is realized by particular the expression. Whether or not a change of content establishes a new work, according to any criteria that can be applied to define this, it is the change in the expression what distinguishes them.

Obviously the previously given class diagram does not faithfully represent the situation, but it would be a mistake to move the type taxonomy to the expression. The mentioned problems of multiple inheritance would subsist at the time of placing in the scheme which we could call "mixed expressions". What makes the difference is not the

expression itself but its contents. The existence of mixed works does not indicate the existence of different types of work but that works can be expressed by more than one content type. Put in terms of object technology, an *Expression* object can collaborate with more than one *Content* object; said in terms of entity-relationship concepts, the *Expression* entity has a *contains* relationship with the entity *Content*, whose cardinality is one-to-many. This allows all combinations, but does not force them to be established a priori. And it keeps the commonly used criteria without tying the model to sociocultural assumptions that may change over time. An opera will always be a work that is realized by an expression that includes two distinct categories of content. Any behavior associated with musical works is not in the work nor in the expression, but in the content; pure musical works and any artistic combination that includes music will delegate everything related to its musical aspect to the corresponding *Content* object, independently of the class hierarchy in which they are. And everything in the system that has to do with music content will be said only once, a must of any programming paradigms.

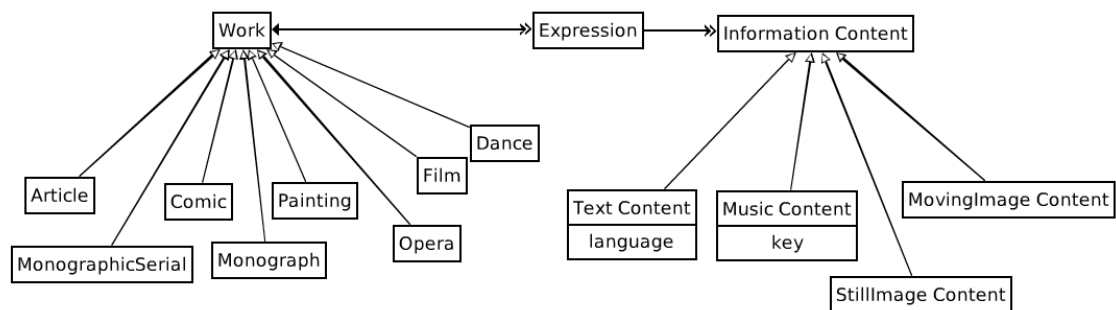


Figure 6

Figure 6 shows in a reduced and simplified way some of the classes resulting from this conclusion. We can see that abstract classes such as *Literary Work* and *Musical Work* have disappeared because they are unnecessary. The attributes of the different types of work—which as we saw, are attributes of every work for FRBR_{er}, such as language or key—are now attributes of specific classes of content: text content is bound to be in a certain language, therefore it is the *Text Content* class which “knows” the language of the work and expression. The problem of FRBR_{er} attributes is solved now: it is not the work nor the expression which answers the question “In what language have you been written?” The work (or any WEMI entity) forwards the question to the *Content* object. The same applies to other attributes as key and medium of performance.

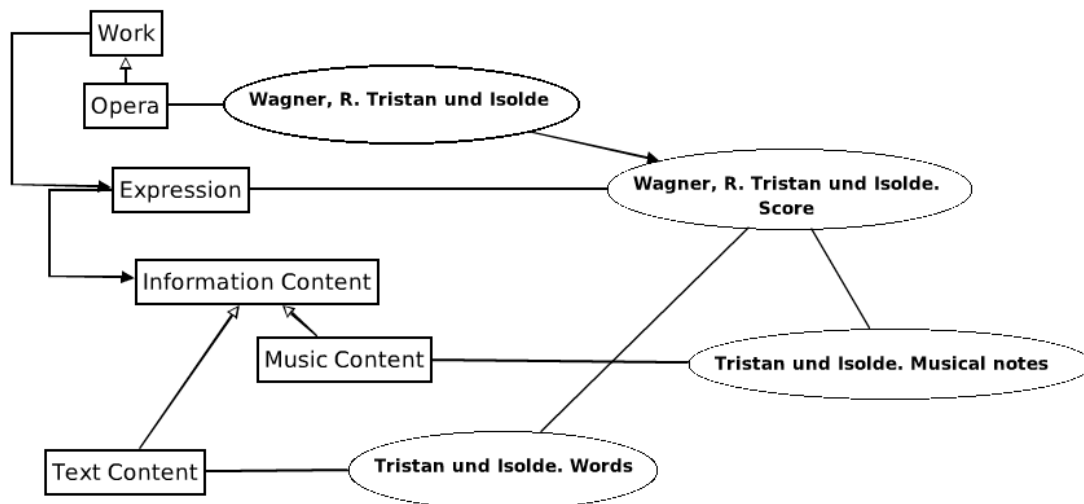


Figure 7

Figure 7 provides examples of specific works, i.e., instances of existing classes. Expressed in FRBR notation, this scheme would be

- w1 Wagner, R. Tristan und Isolde
- - e1 Wagner, R. Tristan und Isolde. Score
- - - c1 Tristan und Isolde. Sound
- - - c2 Tristan und Isolde. Words

in which the letter *c* refers to the *Content* entity.

Conclusion

We must clarify that this presentation has not addressed many issues related to *Work*. As an example of the application of this methodology to other issues we can mention briefly the “foreword issue,” as named by Le Boeuf⁴⁴ and referred to by others^{45 46}: it may be solved defining a *Foreword* class, which as a subclass of *Work*, is a work on its own, as part of an *Expression* keeps its subordinate relationship with the work this expression embodies and as a *Foreword* has the particular type of authorship of this kind of entities.

We believe that the scheme presented here is sufficient to express the benefits of object orientation and design patterns for the analysis of the FRBR model, not only because it can provide inspiration for application developers but because from the analysis clarifications and conceptual rethinking have emerged that contribute to increase our understanding of some theoretical aspects. The emergence of these problems also has shown that some philosophical questions as “What is a work?” are not isolated neither from the conceptual model nor from the implementations that could arise from it.

We have also tried to incorporate the perspective of the user, which is equivalent to that of the whole human species, and as such requires an analysis of all the different cultural patterns and worldviews that come into play in all practices involving bibliographic entities. We are aware that much research is needed in this field to establish a firm direction, so that any appeal to the “user perspective” is necessarily conjectural and

provisional. However, it is essential to resort to that user's perspective, as conceptual models, "can be validated only by agreement of a group of participants who actually need such a model".⁴⁷

Perhaps the most problematic issue is the sustainability of the models and the implementation proposals just because we do not know what changes in the bibliographic universe will be introduced by technologies in the future. Given this, we can only have confidence that arriving at general abstractions which in turn allow us to locate individual entities in a model homologous to what we observe in the bibliographic reality is a minimum guarantee that bibliographic entities that could appear in the future will find their place.

Finally, I wish to thank my colleague Fernando Gómez for his help in reviewing and correcting this article.

Notes

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- ¹ Erich Gamma, *Design Patterns: Elements of Reusable Object-oriented Software* (Reading Mass.: Addison-Wesley, 1995).
- ² 382, 7xx \$m = Medium of Performance; 383 = Numeric Designation of Musical Work; 384 = Key; 8 pos 35= Language; 41=Language Code.
- ³ Ronald Murray, «The FRBR-Theoretic Library: The Role of Conceptual Data Modeling in Cultural Heritage Information System Design» (September 29, 2008), 3-4.
http://www.bl.uk/ipres2008/presentations_day1/26_Murray.pdf.
- ⁴ Martha Yee, «Musical Works on OCLC, or, What if OCLC Were Actually to Become a Catalog?», *Music Reference Services Quarterly* 31, no. 3/4 (2001): 237-295.
- ⁵ Joint Steering Committee for Revision of AACR and Tom Delsey, *The logical structure of the Anglo-American cataloguing rules*, 1998.
- ⁶ Unless it is a mixed work, as a song or an opera. We discuss this issue later.
- ⁷ These attributes for musical works are at very different conceptual levels. Any musical performance involves a medium of performance, while the key only makes sense in certain works: tonal works from Western classic-romantic tradition. While it is true that many of the works after XIX century, despite dodecaphonic revolution, are also tonal, it is quite rare to find the corresponding indication on them. In many tonal works it can not be said they are clearly in a main key, because tonality may flow through different keys. Also works that do not come from the Western academic tradition (i.e. most of the music that is currently recorded) rarely have the corresponding indication, although most of them are unquestionably in a certain key.
- ⁸ Karen Coyle, «Future considerations: the functional library systems record», *Library Hi Tech* 22, no. 2 (2004): 169, <http://www.emeraldinsight.com/journals.htm?articleid=861417&show=pdf>.
- ⁹ Norberto Manzanos and Ana María Flores, «Opus: Sistema de Registro Bibliográfico Basado En FRBR,» in *I Encuentro Nacional de Catalogadores. Biblioteca Nacional 2008*. (presented at the I Encuentro Nacional de Catalogadores. Biblioteca Nacional 2008., Buenos Aires, n.d.).
- ¹⁰ Rob Styles, «Bringing FRBR Down to Earth...», *I Really Don't Know*, November 11, 2009, <http://dynamicorange.com/2009/11/11/bringing-frbr-down-to-earth/>.
- ¹¹ Patrick Le Bœuf, «Brave new FRBR world», 2003, 7.
http://www.imeicc5.com/download/BraveNewFRBRWorld_V5_2007_eng.pdf.
- ¹² Murray, «The FRBR-Theoretic Library», 4
- ¹³ Elaine Svenonius, *The Intellectual Foundation of Information Organization*, Digital libraries and electronic publishing (Cambridge, Mass: MIT Press, 2000), 35-37
- ¹⁴ Patrick Wilson, «The second objective», in *The conceptual foundations of descriptive cataloging*, edited by Elaine Svenonius (San Diego: Academic Press, 1989). 10-13
- ¹⁵ «Antoine Cassar - Wikipedia, the free encyclopedia», s.f.,
http://en.wikipedia.org/wiki/Antoine_Cassar.
- ¹⁶ The poems by this author combine at least five languages, using, for example, a different language on each verse. It is obvious to what extent any translation distorts the original work.
- ¹⁷ Anita Coleman, «A 21st century look at an ancient concept: Understanding FRBR» (presented at the AzLA (Arizona Library Association) Conference, Tucson: El Conquistador Hilton, 2004), 37.
<http://arizona.openrepository.com/arizona/bitstream/10150/105283/1/azla04asc.pdf>.
- ¹⁸ Le Bœuf, «Brave new FRBR world», 2
- ¹⁹ Murray, «The FRBR-Theoretic Library».
- ²⁰ John Helmer, «Cataloging, Economics, and the Experience of Works» (University of California, Los Angeles, 1987),
<http://www.uoregon.edu/~jhelmer/Helmer%20JF,%20Cataloging,%20Economics%20and%20the%20Experience%20of%20Works.pdf>.
- ²¹ Svenonius, *The Intellectual Foundation of Information Organization*, 111-114
- ²² Norberto Manzanos, «Item, Document, Carrier: An Object Oriented Approach,» *Cataloging & Classification Quarterly* 50, no. 5-7 (2012): 439-455, doi:10.1080/01639374.2012.681274.
- ²³ International Working Group on FRBR and CIDOC CRM Harmonisation, «FRBR object-oriented definition and mapping to FRBRer (version 1.0.1)», edited by Chryssoula Bekiari, Martin Doerr, and Patrick Le Boeuf, 2010, 10.
- ²⁴ Ibid.
- ²⁵ William Denton, «FRBR Review Group meeting 2», *The FRBR Blog*, August 13, 2008,
<http://www.frbr.org/2008/08/15/frbr-review-group-meeting-2>.

²⁶ Norberto Manzanos, «¿Quién debe responder a la pregunta “Qué es una obra?”», *Revista Documentación*, no. 20 (November 2010), <http://www.scribd.com/doc/39961533/RD20>.

²⁷ Hans-Georg Gadamer,