Using FRBR for the Selection and Adaptation of Accessible Resources

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Abstract

In this paper we consider the suitability of the Functional Requirements of Bibliographic Records (FRBR) model for an inclusive information environment. The AccessForAll approach to digital information asserts that every user has an equal right to information resources. The FRBR study identified bibliographic records users and, for them, determined a minimum set of entities, and their attributes and relationships, to determine a model of a record or resources that was necessary to satisfy what were, at the time, determined to be recommended user requirements. Our examination of the FRBR model shows that, in fact, more attributes are probably necessary for an inclusive environment.

Keywords:
AccessForAll, accessibility, adaptation, FRBR, MODS, Dublin Core.

1 Introduction

> The aim of the [FRBR] study was to produce a framework that would provide a clear, precisely stated, and commonly shared understanding of what it is that the bibliographic record aims to provide information about, and what it is that we expect the record to achieve in terms of answering user needs. (i) (p. 2)

The Functional Requirements of Bibliographic Records (FRBR) study did not focus on the content or structure of bibliographic records but rather the

> entities of interest to users of bibliographic records, the attributes of each entity, and the types of relationships that operate between entities.

The study used an entity analysis technique, isolating key entities of interest to users of bibliographic records, then identifying the characteristics or attributes associated with those entities and the relationships between entities that are most important to users. Significantly, the report states:

> The model developed in the study is comprehensive in scope but not exhaustive in terms of the entities, attributes and relationships that it defines. The model operates at the conceptual level; it does not carry the analysis to the level that would be required for a fully developed data model.

In this paper, we accept the invitation from the reporting committee to view the FRBR model as a starting point for further work. This is not to suggest that the FRBR study did not achieve its goals. There have been great changes in the world of resources since it was produced and we think it is time to investigate whether the model covers the situations of interest to us. We are aware of the vast range of circum-stances that were considered in the development of the FRBR model, and that it did not attempt to specify in detail for each possibility, but ask whether it was concerned at all with what is now a major development in the provision of accessible resources, namely, the capacity of computers to match or tailor resources to suit individual user's needs and preferences at the time of delivery.

We investigate this issue with respect to the FRBR model not only because that is such a useful model but also because it is an abstract model against which many metadata models can be evaluated for coverage of user requirements. Although the FRBR model is said to relate to bibliographic records, and was focused on them in the beginning, it has been interpreted for use in the digital information world (ii).

FRBR defines three groups of entities. Entities of the first group represent different aspects of user interests in the objects of bibliographic description. Entities of the second group represent those responsible for content and/or production, and the third group of entities represents subjects. In this paper, the group one entities, which represent the four different aspects of resources, are the focus.

Previously, Morozumi (iii) has done extensive mapping of metadata schemas to the FRBR model to investigate the use of the FRBR model to match the intellectual content needs and preferences of users, and how resources with the same or similar intellectual content but presented in different forms, can be understood. This paper builds on that earlier work and other work to do with AccessForAll accessibility by Nevile (iv).

In some cases, metadata models have specific and narrow requirements they aim to address. In our case, we work with the Dublin Core Metadata Terms (DCMT) (v) that are designed to be a minimal interoperable core set; the Metadata Object Description Schema (MODS) (vi) which is designed to bring descriptions from MARC catalogue records into use as XML metadata, and ISO JTC1 AccessForAll metadata (vii) for adapt-ability for accessibility purposes.

We note that most countries have legislation requiring the provision of accessible resources, often described as anti-discrimination legislation; that adaptability of resources is often essential to the provision of resources in formats they can use, and thus the significance of essential metadata relating to the adaptability of resources.

2 Methodology

We adopt the definition of the user requirements of an inclusive environment (viii) from the ISO JTC1 SC36 standard for Personal Needs and Preferences (PNP) (ix). The PNP is a metadata set that makes explicit the restrictions on accessibility of a user at the relevant time. As some users have very few access abilities, their preferences are often essential needs whereas other users may have some flexibility despite their access

restrictions. We compare such user needs with those on which FRBR was based to determine to what extent they were included explicitly or implicitly. These two standards provide a stable set of AccessForAll requirements and attributes/relationships that are intended to be used with many metadata sets that focus on the other aspects of resources. We then consider the FRBR model to see if it indeed provides for these requirements by considering the relationship between the FRBR attributes and relationships and those of metadata that is required for adaptability, basing our definition of these on the ISO standard for Digital Resource Description (DRD) (x).

Finally, we map DC and MODS elements to the FRBR model to determine to what extent the DC and MODS sets provide for adaptability in the way necessary to support accessibility of resources.

3 User requirements

The AccessForAll approach, realized in a forthcoming JTC1 ISO SC36 standard for education (xi), provides a new, metadata-based approach to accessibility, particularly for the benefit of those with disabilities. In an inclusive environment, it is not sufficient to deliver an item with the required intellectual content. It must also satisfy the user's accessibility needs and preferences. This places greater emphasis on various characteristics of the item than has previously been necessary.

A poem engraved on a tombstone, shown in a photo of the tombstone, is not accessible to a blind person: although the genre of 'poem' is text, the resource is an image so the user interaction is based on vision. A blind user will need a tactile or auditory version of the intellectual content, both of which can be delivered from a range of *manifestations* other than an image, including textual and Braille versions and an audio recording.

There are many situations in which users have constraints for their use of resources that go beyond the limitations of their devices and that are not necessarily associated with any disabilities. Being near a noisy construction site may limit the use of a given resource (the user may need an alternative to an auditory resource). A user with limited vision may need resources without images. Whether such needs arise because the person is blind or because they are driving a car; their functional requirements are the same.

An automated accessibility service will determine the suitability of a resource and, if necessary, replace or augment it with an appropriate one. This process of matching is known as the AccessForAll accessibility approach and is already being implemented in educational systems (xii).

Many people assume that if a user has special requirements, such as large yellow text on a deep blue background, that they would state this as a requirement and the accessibility service would match resources to this requirement. Although it is possible to find a single resource with such characteristics, in a world where digital resources are rendered *on demand* for users, this does not always work. A book, on the other hand, either has large text or it doesn't, or has black on white text or some other combination. Web resources, such as Web pages, do not necessarily have a fixed form.

Some files (e.g. PDFs) transmitted via the Web may have a fixed form; many Web pages do because they are constructed that way. Users' needs and preferences should be described in a generalized way so they can be used across all types of resources, static (as a book or badly constructed Web page), or dynamical, as in most cases.

Users sometimes specify their needs in style sheets and simply direct their Web browsers to use their personal style sheet in preference to that of the content provider. In such a case, the user needs a resource that has its presentation separated from the content so that their style sheet will work. In other cases, the user will have to specify

their needs in detail in a machine-readable profile that can be applied by an accessibility service.

3.1 Personal Needs and Preferences

The personal needs and preferences of a user, including an agent, can be described using the ISO AccessForAll standard. This Personal Needs and Preferences profile is known as the PNP. Once a resource is *found*, and *identified*, it is *selected* for a user (FRBR terms).

The PNP was developed by a community that is (possibly too) familiar with the W3C *universal design* approach to accessibility. The PNP assumes, according to that approach, that a user with special presentation needs such as particular font sizes will be satisfied if the resource is accessibility compliant according to the relevant criteria, as detailed in the W3C WCAG (xiii) and considered to be part of the conformant use of markup languages such as XHTML (xiv). The PNP is structured so that at one level, display transformability is required, and then, at a lower lever, the details of the transformation are recorded. (This structured approach is consistent with the DCMT ideas of generalization contained in the 'dumb-down rule'.) A user who needs a font size of xx, needs a resource that exactly fits their specifications or a resource with a display that can be transformed.

There are three categories of user accessibility adaptation requirements: control, display (or presentation), and content.

Control issues include limits on the user interface, such as a current inability to use a mouse.

Display or preference issues include such things as particular font sizes or colors, screen reading of text, or layout of a tactile presentation as Braille, etc.
Often the most important requirement is the mode of interaction with the content. This can be set by the PNP as any combination of visual, auditory, tactile, olfactory and textual. Although 'textual' is different in kind from the others, it is a form that, if properly constructed, can be transformed automatically into auditory, adapted visual (such as large font), or tactile Braille (in most cases). There are other characteristics included such as avoiding a hazard that occurs with flashing objects that can cause some people to have seizures, and the need for inclusion in the resource of support tools, such as a dictionary.

In terms of content needs, personal preferences might be such as that text should be of a certain reading level, in a particular language, etc. (Note that even some of these characteristics are now becoming transformable given the range of services emerging on the Web.)

3.2 PNP users and FRBR Users

FRBR users are not just end-users of resources:

> the users of bibliographic records are seen to encompass a broad spectrum, including not only library clients and staff, but also publishers, distributors, retailers, and the providers and users of information services outside traditional library settings.
> The study also takes into account the wide range of applications in which bibliographic records are used: in the context of purchasing or acquisitions, cataloguing, inventory management, circulation and interlibrary loan, and preservation, as well as for reference and information retrieval. (p. 4)

FRBR references:

> the importance to users of aspects of both content and form of the materials described in bibliographic records. (p. 4)

FRBR attends to users' interests in the range of formats and genre in which intellectual content is available. Thus, if a resource can be found that satisfies the requirements in the user's PNP, it may be said that FRBR includes these requirements.

In our interpretation, however, this does not include the adaptability of a given resource. We make this assumption because there is no reference to digital as opposed to physical resources, nor to adaptation of them and, as a study, FRBR predated the adoption of technology that supports the adaptation processes.

The technology now being used in this context includes computer mark-up and other languages that support adapt-ability of resources, such as Cascading Style Sheets (xv), Scalable Vector Graphics (xvi), eXtensible Markup Language (xvii) and, in particular, the W3C guidelines for using these technologies to promote accessibility.

While a resource might have the specific characteristics initially required by the user, the failure to satisfy adaptability requirements means that the user cannot change the resource if their requirements change as they interact with it. This is considered an essential characteristic of accessible resources, and so, even if the resource is initially accessible to the user, unless it is transformable (and similarly control flexible), it will not be considered suitable by an AccessForAll accessibility service. This concept may be considered a failing of the AccessForAll principles but it is also the principle behind the W3C specifications, showing it is considered important by those who work in the field. It is a noted problem, however, and implementers should be advised to ensure that a resource is not missed because of it.

In the FRBR study, the bibliographic records were stated to:

> cover the full range of physical media described in bibliographic records (paper, film, magnetic tape, optical storage media, etc.); they cover all formats (books, sheets, discs, cassettes, cartridges, etc.); and they reflect all modes of recording information. (p. 7)

It seems a reasonable assumption, even given these comments, that the records are for the physical objects that are produced, even by digital means, but not that they are for digital resources for use in an electronic environment in which they could be transformed or adapted on-the-fly, as required by the AccessForAll model.

In the description of the entity known as *item* in the FRBR model, the thing that is finally delivered to the content user, the physical form of the object, or set of objects, is emphasized. (p. 23)

> The study takes into account the wide variety of applications, both within and outside a library setting, in which the data in bibliographic records are used: collections development, acquisitions, cataloguing, the production of finding aids and bibliographies, inventory management, preservation, circulation, interlibrary loan, reference, and information retrieval. (p. 8)

Although there is no mention of any-thing like the adaptation of resources in this list, it is possible (but unlikely) there was an awareness of the problem expressed in the details of record use:

> to determine the physical requirements for use of an item as they relate either to the abilities of the user or to special requirements for playback equipment, computing capabilities, etc. (p. 8)

In the end, the FRBR model assumes four user tasks: *find*, *identify*, *select* and *obtain*.

We conclude that the FRBR user requirements did not include those contained in the PNP.

4 FRBR entities

The FRBR model is based on entities considered to be of interest to users for the tasks identified by the FRBR study. The work on these entities makes it clear how resources, as delivered (or obtained), may be closely related to each other through the association of abstract entities.

In this paper, we are concerned mostly with the processes of selection and adaptation of resources, and so characteristics of the *manifestation* and *item*, according to the FRBR entities model. The FRBR study claims that:

> Defining item as an entity enables us to separately identify individual copies of a manifestation, and to describe those characteristics that are unique to that particular copy and that pertain to transactions such as circulation, etc. involving that copy. Defining the entity called item also enables us to draw relationships between individual copies of manifestations. (p. 23)

As an example, we consider Shakespeare writing the play Othello and its translation into Japanese. Both endeavors are considered to be significant intellectual exercises leading to concrete output. FRBR abstracts two entities, *work* and *expression*, from the concrete *manifestation* of the plays that are reproduced as *items*.

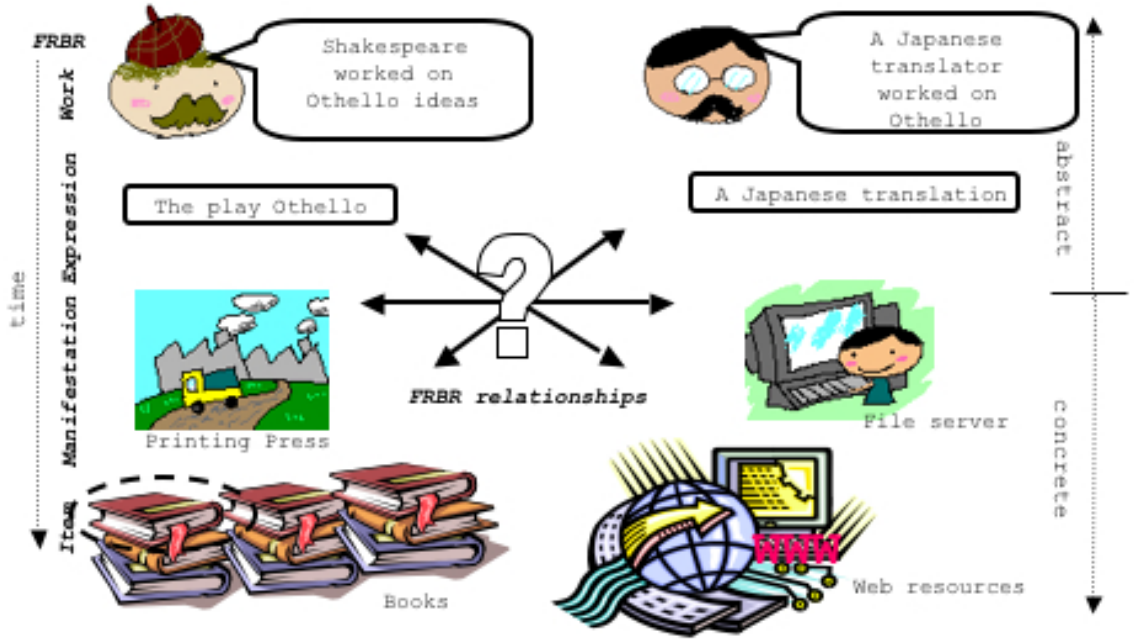

Figure 1: Diagram showing 4 FRBR entities associated with two resources and their possible relationships.

4.1 FRBR entity relationships

The relationships of interest in the FRBR model, that help both distinguish and show similarities between entities, include such as *based on*, *translated from*, and they include relationships between entities as well as across entities, i.e. between an *expression* and its *manifestation* as well as between two *manifestations*. In particular, the relationships between entities based on their subject, is of interest to us. These include such as: *adaptation*, *trans-formation*, *complement*, *supplement*, etc. Where such relationships are recorded in the metadata, they can be of special value in the adaptation situation.

It should be noted, however, that the FRBR entity relationships can transcend an individual entity to one that is related by other relationships, that is, it may not be between two entities such as two *manifestations,* but rather through some abstract entities such as the *expressions* or *works* from which the concrete entities are derived. While this is a limitation in as much as a core metadata system such as the DCMT will not be suitable for recording this information, it is very useful to know of its existence.

4.2 FRBR entity attributes

In our case, it is the individual *items* that will need to match the user's accessibility requirements and so the adaptability of the *manifestation* that is of interest. We assume that whenever a resource is adapted, the intellectual content is maintained while the access to that content is adapted. This is true even when alternative content is required because the original content cannot be transformed or controlled. This means that the *work* and *expression* attributes of an alternative resource may vary as well.

We considered the attributes of *works* and *expressions* that are relevant to the accessibility adaptations and find that the only one is *form*.

With respect to a *work*, the *form* is the class of *work* or what might be called the genre, while the *form* of an *expression* is "the means by which the work is realized (e.g., through alpha-numeric notation, musical notation, spoken word, musical sound, cartographic image, photographic image, sculpture, dance, mime, etc.)." (p. 36)

FRBR's *form* is thus quite closely related to the access mode that is of importance in the accessibility context. A *work* that is realized in dance *form* will need to be presented to an eyes-busy user (e.g. car drivers) as an audible description, and so *manifested* as textual (FRBR's alpha-numeric notation) for automated reading, or auditory (FRBR's spoken word).

It is at the stage of realization (or instantiation) of the various *forms* of *expressions* into *manifestations,* that the potential for adaptability for accessibility is enabled.
So we closely examine the attributes of *manifestations* and *items*.

4.3 Access adaptability descriptions

Although the FRBR model includes an 'access mode' attribute for *manifestations,* it does so with a very different meaning from the AccessForAll work. The only attributes of *manifestations* that may impact on resource accessibility adaptation are:

- 'capture mode' (of interest to those selecting kinds of auditory alternatives);
- 'color' (for those with color restrictions but the attribute is missing what is often critical, information about whether the color is an essential conveyer of the intellectual content), and
- 'file characteristics (electronic resource)' which are defined to relate to "characteristics that have a bearing on how the file can be processed" including things such as the encoding schemes and languages. (p. 48)

We note again that these attributes may be used to determine if a resource with fixed characteristics matches a user's needs while those needs are stable, but it would not help when the user's needs change.

We look next at the attributes of interest with respect to an *item* in the FRBR model.
While we are told that "The attributes defined for the purposes of this study do not include those associated with transactions of an ephemeral nature such as the circulation or processing of an item" (p. 49), we note that such processing is not of the type envisaged for adaptation of resources. We found no attributes of the entity class of *items* that relate to the adaptability of resources to satisfy varying personal accessibility needs

and preferences of users. This does not surprise us because we have already identified the other entities (*manifestation*, *expression* and *work*), to be the relevant entities.

There are still other entities dealt with in the FRBR model, including 'person'. Although it may seem relevant, FRBR is concerned with descriptions of people but the AccessForAll approach is explicitly avoiding descriptions of people. AccessForAll strictly avoids assumptions that needs and preferences are descriptive of people, instead treating them as choices people make. This avoids defining people by their disabilities.

We therefore conclude that the FRBR model does not, implicitly or explicitly, cater adequately for the adaptability needs and preferences of users.

4.4 Metadata Schemas and FRBR

FRBR is not a metadata schema and is not intended to be one. It is not implemented as metadata anywhere. It is a model for use by those who are working on metadata for user requirements. It was based on some well-established principles for metadata (at that time called bibliographic records), and usually applied to physical objects. It follows the traditions associated with bibliographic records but, nevertheless, FRBR provides an excellent base for the mapping and thus comparison of the many metadata systems now available.

We considered the relationship between the FRBR relationships and attributes of entities and Dublin Core Metadata Terms (DCMT), the MODS terms, and the ISO JTC1 Digital Resource Description (DRD) terms.

We found that DCMT (properties) describe what FRBR calls attributes of entities with the exception of the relation element. dc:relation is useful for describing relationships that can be of interest in the adaptability context, as demonstrated in the emerging DC Application Profile for AccessForAll adaptability (xviii). The relationship between the attributes of dc:format and dc:type would be of interest but this depends on implementations, and is not in the metadata per se. dc:description and dc:audience may also be useful, depending on their use.

With MODS, we found a similar situation. Mostly MODS describes attributes, in the FRBR sense, but it does have a property relatedItem that could be useful in the adaptability context.

We found very little in common between the elements of the DRD and the FRBR model, which did not surprise us for the reasons already given above. Also, the DRD was designed to complement existing metadata schemas, not to duplicate them.

These results led to our observation that the DCMT and MODS terms are limited in respect of accessibility adaptability in the same way as is the FRBR model.

It is asserted then, that as the DRD represents the information as metadata that is required in the description of a resource to indicate its adaptability for accessibility, neither the FRBR model, nor examples of metadata such as the DCMT and MODS that are closely related to it, provide the metadata necessary for accessibility adaptability.

5 Future Work

As described above (Section 4), *form* is the only attribute of FRBR *works* and *expressions* that relates to adaptation. On the other hand, there are attributes of *manifestations* that relate to characteristics of a resource that may need to be adapted, such as *capture mode*, *typeface* and *type size*. Fortunately, these are attributes of the resource that may happen to be suitable as they are for the user so that a resource as identified for delivery may satisfy the exact requirements of the immediate user. In one sense, that is all we are concerned with. Unfortunately, though, while they are identified

and described in their existing state, there are no attributes indicating if they are adaptable.

What this means in the FRBR context is that while it may be possible to determine if a particular resource suits a user by reference to that user's PNP, it is not easy to tell from FRBR type descriptions of resources if they will be adaptable as those requirements change.

Today, resources are so different from those originally considered by FRBR that one might hesitate to try to include them in the FRBR model. It is a question for further consideration then, whether the FRBR model should be extended to include attributes that describe the adaptability or just those that describe the current state of the resource, or not at all.

We believe the first choice is compelling in a world where adapt-ability is constantly being practiced as people change devices, locations, goals and tasks and almost all the devices used include some intelligence and adaptability capabilities.

While the majority of attributes of *works* and *expressions* are descriptive of the intellectual content of the resource, those of the *manifestation* are generally more relevant to the presentation of that content or interaction with it. This suggests we can focus on the attributes of *manifestations* when developing the requirements for resource selection for adaptation to individual user needs.

The dynamic nature of *manifestations* and *items* enables the AccessForAll adaptability approach, in accordance with the needs and preferences of users. As these are specified in the DRD, that standard would provide a good starting point for consideration of extensions to the FRBR model.

6 Conclusion

In this paper, we reported on a close examination of the requirements of users as defined for the FRBR study in 1998. We showed that the requirements at that time, and as used in the FRBR work, did not include those that are now considered necessary for an inclusive information system. We based our definition of user requirements on a new ISO standard and the information needed for those users on a matching ISO standard for the description of resources. We found no evidence that the FRBR model would provide such information. We found that none of the DRD metadata terms were included in the FRBR model. We mapped the DCMT and MODS metadata terms to the FRBR model and found that those metadata schemas had similar short comings.

We note that the FRBR model is beginning to influence the development of metadata schemata, particularly for resources that have many manifestations, such as in repositories for visual resources that are digitized and replicated in many formats. We conclude there should be an extension to the FRBR model that provides for a more inclusive information environment for users We consider that this would bring the FRBR model more closely in line with what is happening in general with the Web, and its evolution towards what has been called Web 2.0. We hope that such an extension would also result in more attention in metadata systems on the information needed for accessibility.

We hope that even if the FRBR model is not reviewed and reformed, that organizations such as those responsible for the DCMT and MODS will take account of the need to support work based on the AccessForAll approach and consider extensions to include the metadata necessary for adaptation for accessibility for resources.

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