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Anticipating new media: A faceted classification of material types

Abstract: The emergence of new media types, many seemingly without counterparts in the non-digital world, challenges the readiness of existing knowledge organization schemes to accommodate them. A knowledge organization scheme based on a faceted analysis of existing classes of bibliographic materials is likely to accommodate new developments better than one based on a list of unanalyzed material types. The faceted analysis undertaken here, in which seven facets are recognized (content, generation of content, recording of content, publication/distribution, physical characteristics, perception/use, and relationships) shows the inadequacy of the traditional view of the bibliographic community of a fundamental distinction between content and carrier; interaction between content and carrier is common and enters into the characterization of material types. The facet analysis is validated by applying it to two new material types, wikis and blogs.

1. Introduction

The modern bibliographic world recognizes a fundamental distinction between intellectual content and physical carrier. As Lubetzky (1969) put it: "The book . . . comes into being as a dichotomic product — as a material object or medium used to convey the intellectual work of an author." This differentiation between intellectual content and its carrier is evident in many arenas. For example, it underlay the distinction between description and access permeating AACR2: Prior to the 2001 Amendments, rule 0.24 directed that bibliographic description should be based on a document's physical form, while rule 20.1 continues to state that "the rules [dealing with access points] apply to works and not to physical manifestations of those works" (Howarth, 1997, 2-3). The distinction is echoed in the treatment of bibliographic entities in *Functional Requirements for Bibliographic Records* (FRBR, 1998), where the vocabulary of 'work' and 'manifestation' continues to reflect intellectual content on the one hand and physical form on the other hand. A collective analysis of documents undertaken by the CNRS Information and Communication Science and Technology Department (Pédauque, 2003) isolated three document dimensions: document as form (corresponding to carrier), document as sign (corresponding to content), and document as communication vector (emphasizing its social character). The *RDA/ONIX framework for resource categorization* (2006) continues to maintain the distinction, being built around sets of attributes for resource content and resource carriers.

In recent years, a more nuanced view of content and carrier has begun to surface. Rather than casting carrier and content as distinct and orthogonal entity types, the emerging view notes

the interdependence of content and carrier. For example, Howarth (1997, 6) writes: "Some types of items have distinctive physical characteristics which need to be described in a record to make individual entities . . . unique. . . . In some cases, . . . interpretation or use of an item is dependent on its physicality." While explicit recognition of this interdependence is of recent vintage, implicit recognition of it is built into the variety-within-unity approach of the description part of AACR2–with its individual chapters for different classes of materials, all of which derive from a single pattern (i.e., the bibliographic description of books)–and more especially is built into its use of a material-specific area.

Another development in our understanding of the content vs. carrier issue questions whether there may be the need for intermediate bibliographic categories between pure intellectual or artistic content and pure physicality. For example, in addition to content and physical carrier entity classes, Delsey (1998) also posited an entity class that formats the content and another entity class that stores the formatted content. This development is also evidenced, in a different way, in FRBR's notion of an expression, which realizes a work and which is embodied in a manifestation. It is at the expression level that we register, for example, the difference between two editions of a work, the difference between two translations of a work (in the same or in various languages), the difference between different interpretations of an artistic performance, and the difference between a printed version of a text and the audio (or audiovisual) recording of the text being read (or performed).

Recognizing that differences between editions, translations, interpretations, and forms of expression are significant reflects the inadequacy of positing only purely intellectual and purely physical bibliographic classes; amalgamating editions, translations, interpretations, and forms of expression into a single entity class reflects the incompleteness of our thinking at this stage. This paper addresses this condition by applying faceted classification principles to our characterization of classes of materials, with the goal of being better able to accommodate new media types. Section 2 briefly surveys recent literature on content and carrier issues, focusing on literature that addresses the middle ground between intellectual content and physical form; section 3 then addresses the import of gaining a better understanding of these issues. Section 4 explores the interaction of content and carrier by considering some of the kinds of distinctions that need to be reflected in bibliographic description. The part that follows, section 5, presents a data model that ranges across content and carrier areas, with greatest emphasis given to attributes needed for characterizing intermediate bibliographic categories. The final section, section 6, summarizes the paper's evidence and findings.

2. Literature Survey

In an analysis of the logical structure of the Anglo-American Cataloguing Rules (AACR), Delsey (1998, 7, 11), modeled a bibliographic item as a serialized set of relationships. A document consists of content, which is set as an infixion, which is stored on a physical carrier, which may be housed in a container. He defined the participating entity classes in the following manner (8-9):

- A "DOCUMENT . . . is an object that comprises intellectual and/or artistic content and is conceived, produced, and/or issued as an entity."

- "CONTENT . . . is the intellectual or artistic substance contained in a document."
- "INFIXION . . . is the formatting of intellectual or artistic content."
- A "PHYSICAL CARRIER . . . is a physical medium in which data, sound, images, etc. are stored."
- [A] PHYSICAL CARRIER may (or may not) be "housed in" a CONTAINER."

Documents belong to a class of materials and, if published, to a type of publication.

CONTENT and INFIXION attributes are internally organized by classes of materials. For example, while all CONTENT can be characterized in terms of, *inter alia,* nature of content, scope of content, purpose, and intended audience, cartographic content is also characterized by scale, projection, coordinates, equinox, and magnitude, and musical content is also characterized by form of composition, medium of composition, musical presentation, form of notation, and duration. All INFIXION attributes are specified with respect to a class of materials: INFIXION attributes for film include aspect ratio, projection speed, sound characteristic, and form of print, while INFIXION attributes for computer files include recording density, sectoring, and, again, sound characteristic.

More recently, an RDA working group proposal for translating AACR's GMD and SMD features (general and specific material designations) into FRBR's structural model was circulated. The proposal called for each resource to be assigned a broad content term (e.g., data, moving image, music notation, music recording, sound, textual) and both a broad carrier term (e.g., audio, digital, graphic, multimedia, printed, projected) and a specific (type of) carrier term (e.g., DVD audio, JPEG file, score) to reflect the manifestation categories that the resource belongs to (*Content and Carrier Terms in RDA,* 2006, 1-2). (The document [p. 10] notes that consideration should be given to renaming the content element to avoid confusion with content as 'subject matter'; alternatives suggested include 'communication vehicle,' 'method of communication,' and 'class of material' to reflect the work or expression category that the resource belongs to.) A subsequent RDA section draft clarifies further. The content term "[reflects] the fundamental form of communication in which the content is expressed and the human sense through which it is intended to be perceived"; for images, it also reflects dimensionality and the presence/absence of motion (Delsey, 2006, 9). The broad carrier term represents the "media category" of the document, "reflecting . . . the type of intermediation device required to view, play, run, etc., the contents of the resource" (Delsey, 2006, 5), while the specific type of carrier term "[reflects] . . . the format of the storage medium and housing of the carrier"; values for the latter are suborganized under values for the media category (p. 7). Such RDA developments aptly demonstrate the multidimensionality of carrierness.

3. Significance

Why should we care about these issues? First, conveying how a document's content is expressed can help end users identify relevant materials and filter out non-relevant materials (Guerrini, 2004, pp. 62-63). Second, apt characterization of a document's carrier-related attributes can also help an institution identify its holdings. Naturally, the better this information is conveyed, the more likely it is that a bibliographic description will facilitate these ends.

What would it mean to convey this information well? The system for conveying information should be comprehensive, permitting all possible attribute values to be expressed at varying levels of specificity. The system should be structured in such a way that relationships among attribute values can be easily discerned and manipulated. The information should be expressed in a manner that is intuitive to end users.

While intuitive expression is key for helping users achieve identification and filtering goals, it can be handled through mapping natural language expressions to (combinations of) less intuitive attribute values. That is, the need to offer a user-friendly surface-level interface can be divorced from the issues surrounding the completeness and relational structure of the underlying system.

The existence of a complete and well-structured system for conveying carrier information would result in a clean(er) database structure, which, in turn, would better extend to new media, especially digital media (Delsey, 1998, 1, 25-35; Liu, 2004; Reynolds, 2000). A faceted classification of material types would allow for and encompass emerging and future media types without needing major rule revisions to accommodate them, thus allowing bibliographic control to keep pace with changing technologies more efficiently.

4. Content-and-carrier: An impoverished metaphor

In the traditional view, the carrier is the physical medium in which intellectual content is housed; this content / carrier distinction mirrors what was previously referred to, in a world of considerably less variety of media, as a book / work distinction. But despite its common use, the truth of the matter is that the physical / intellectual distinction does not make as clean and insightful a divide as might seem apparent on the surface.

To see the point, let us imagine a very different sort of content and carrier, a scoop of ice cream perched on a cone. (While we're imagining, let's make that a double scoop of Häagen-Dazs vanilla swiss almond ice cream on a sugar cone, please!) The ice cream is the content, the cone the carrier. Is there anything in the ice cream that parallels the notion of intellectual content? In fact there is, as many of the positive sensations we associate with ingesting ice cream are cognitive in nature: On the most fundamental level, the vanilla, chocolate, and almond flavors are taken in and enjoyed on a cognitive level. But flavor alone does not tell the story. We also have a cognitive enjoyment of the creamy texture of the ice cream, which contrasts with the chewy texture of the almonds and the crispness of the chocolate that coats them. But is, for example, the chewy texture of the almonds really part of the "intellectual content" of the ice cream? Or is it the physical medium that conveys the almond flavor? Or is it both? And as for the cone—our carrier—clearly it is edible and so has its own sense of flavor and texture. Is it both content and carrier?

It would be easy, but unwise, to push the parallels between bibliographic entities and ice cream cones too far. But still, do we see any of the melding of intellectual / cognitive content and physical medium in the bibliographic world that exists in the world of food? Yes, we do. In the same way that we cannot separate the flavor of foods from their texture, we cannot divorce the pure intellectual / cognitive meaning of a work from the signs—the visual images (including words), the sounds, the tactile phenomena—used to convey it. The signs are carriers, but the

signs are also content. There is perhaps as much of intellectual content in a writer's selection of words, a composer's selection of notes, a painter's selection of colors and shapes as in the ideas or feelings that motivate the work. While there is pure intellectual content (thought) and pure physical carrier (e.g., the container that houses an information package), most of what we deal with in the bibliographic world lies in an intermediate arena where content and carrier aspects both apply. The FRBR expression level especially lies in this intermediate zone, which also bleeds into both work and manifestation levels.

We will use two sets of works with a selection of related expressions and manifestations to further explore the content and carrier mix. The first set focuses on a play, the second on a musical composition.

Let us begin with a play named *Still Playing in Your Hometown*. The following bibliographic entities could be members of its family:

- The playwright's manuscript copy (subsequently missing a page)
- A digitized version of the manuscript copy
- The (original) published text
- A subsequently published text, with:
  - photographs from a performance
  - notes from the director of the performance
  - updated dialogue
- An audiorecording of a reading of the play
- A videorecording of a performance of the play

Let us also imagine a musical composition named *Music to My Ears*. The following bibliographic entities could be part of its family:

- The composer's manuscript copy (subsequently autographed)
- A microfilmed copy of the composer's manuscript
- The score, transposed into a different key, but otherwise identical to the original
- The score, arranged for a different set of instruments
- A piano roll that captures a performance of the composition
- An audiorecording of a performance of the composition
- A videorecording of a performance of the composition

Clearly in both cases, many other expressions or manifestations can be imagined, generated by using different combinations of attributes alluded to in the examples. Because these attributes represent many different facets, the number of potential combinations is large.

How can we determine the facets? On one level, all of the bibliographic entities in the first group are the play and are thus the same thing; all of the bibliographic entities in the second group are the musical composition and are thus the same thing;. On another level, however, they are different. Those differences can be used in isolating the dimensions (facets) that characterize different material types, for example:

A. The play, *Still Playing in Your Hometown*
   1. The entire manuscript copy vs. some portion of the manuscript copy: This difference reflects the need to distinguish between a whole and its component parts.

2. The manuscript vs. a digitized version of the manuscript: This difference reflects the needs to express the relationships between an original and some reproduction of it and to distinguish between different methods of recording the content, in this case, between a handwritten textual version of the play and a mechanically reproduced, digitally encoded version.
3. One published version vs. another published version: This difference reflects the need to distinguish between different expressions of the content.
4. The text of the play vs. supplementary material related to the play: This difference reflects the need to relate two bibliographic entities in which one plays a subsidiary role to the other.
5. The text of the play vs. a reading of the play vs. a performance of the play: This difference reflects the need to distinguish among different realizations of the content, that is, among a written text, an audio version of the text, and an audiovisual version of the text, plus accompanying action.

B. The musical composition, *Music to My Ears*
   1. The manuscript vs. a microfilmed version of the manuscript: In addition to reflecting the need to distinguish between different methods of recording the text (as in A.2 above), this difference also reflects the need to distinguish between visual bibliographic entities on the basis of the size of their images and the concomitant need (or lack of need) to use special equipment to access the content.
   2. The composition in one key vs. the composition in another key: This difference reflects the need to relate two musical bibliographic entities (whether scores or sound recordings) that vary only by their different tonal centers.
   3. The composition, scored for one set of instruments vs. the composition, scored for another set of instruments: This difference reflects the need to relate two musical bibliographic entities (whether scores or sound recordings) that vary only by the set of instruments assigned to various lines.
   4. A visual rendering of a performance of the composition (e.g., a silent movie) vs. a tactile rendering of a performance of the composition (e.g., a piano roll) vs. an aural rendering of a performance of the composition (e.g., a sound recording): In addition to reflecting the need to distinguish between different methods of recording the text (as in A.2 above), this difference reflects the need to distinguish among the sensory systems that could be used to access the content.

5. Data model

This section presents a preliminary data model of material types, based on the principles of facet analysis. Greater emphasis has been put on identifying and organizing relevant facets and subfacets than on enumerating exhaustive lists of isolates. Indeed, considering the preliminary nature of the data model, the isolates listed should be taken primarily as clues to the meaning of the facets

5.1. Data sources

The preceding analysis of distinctions needed in a model of material types, though far from complete, gives some sense of the variety of the aspects that would need to be taken into account in a full-fledged facet analysis of material types. The preliminary model presented in this section has benefited from examining a wider variety of material types. The sources for these material types include:

- Developments for material types within the Dewey Decimal Classification (at 011.3 General bibliographies of works published in specific forms; 025.34 Cataloging, classification, indexing of special materials; 070.57 Kinds of publications; and 302.23 Media (Means of communication); data examined include:
  - Captions at the classes just listed and all classes under them
  - Including notes (potential subclasses of a class)
  - Class-here notes (topics that approximate the whole of a class)
  - Relative Index headings for a class
  - Library of Congress subject headings that have been mapped to a class
- General material designations (GMDs) and specific material designations (SMDs) from AACR2
- Document types enumerated in wikipedia.org hierarchies

Examination of data from these sources has not been exhaustive. Rather, material types from these several sources were scanned to identify those based on differences not previously isolated. The appendix lists a representative sample of the material types examined.

5.2. Analysis

Analysis of any particular material type began by identifying its important characteristics and determining how it is distinct from other material types. From this we identified a number of characteristics that documents can have (e.g., dimensionality, size of image, method of recording, seriality, fixity). We then grouped together characteristics that are attributes of the same entity class to identify facets important to material types. By following this procedure, we identified seven facets: content, generation of content, recording of content, physical characteristics, publication/distribution, perception/use, and relationships, which will each be briefly discussed in its turn.

Although we have traditionally contrasted content and carrier, they are not entirely separable. For one thing, the nature of the content often dictates (or at least restricts) major aspects of the carrier. For example, geographic content can be conveyed in textual descriptions (in print or as read), but is usually best conveyed with maps (globes, atlases). Statements of scale, projection, or coordinates would be relevant for maps, but not for textual descriptions of geographic content. For another thing, some material types presuppose a certain kind of content (e.g., newspapers, yearbooks) or source (e.g., government reports).

Some material type designations take into account the generation of content, specifically how many persons (agents) are involved in the generation of the content (e.g., single-author documents), how they interact (e.g., wikis), and whether content, once generated, is fixed,

subject to change at discrete times (e.g., subsequent editions of printed works) or subject to continuous change (e.g., blogs).

Content further affects material type in terms of how that content is recorded. The symbol system used to record content—whether language, music, picture, or data—strongly influences our perception of material type. For example, many of the material types around which AACR2 is organized (e.g., books, cartographic materials, music, sound recordings, motion pictures, graphic materials, electronic resources) give clear signals to the symbol system used in them. AACR2 material types are also correlated with the method of recording the content. For example, by definition manuscripts are generated by hand. In rare cases (as with incunabula), a material type may derive from when the content is recorded.

Publication and distribution aspects also play a role in defining material types. Some material types (e.g., wikis) depend on the manner in which content is distributed: The combination of distribution of content on physical media makes no sense with respect to wikis, for example; this material type implies online distribution. Serials are defined by their recurring publication; limited editions are defined by the number of published instantiations of a physical document.

Physical characteristics are fairly oblivious to issues of content, except insofar as some kinds of carrier-related data are specific to the recording of the content (for example, size and quality of image are not relevant for sound recordings). Other physical characteristics that define material types include the type of materials used in the carrier (e.g., birch bark documents, board books), the quality of the materials (e.g., commonplace books, colonial editions), and so forth.

Material types may also be characterized with respect to how they are used or perceived. The sensory system(s) used in perception defines such material types as visual materials and audiovisual materials. Some material types cannot be used without enabling technology: Film, for instance, requires some kind of projection; microforms require equipment to enlarge the image. Other material types are characterized by their occurrence or use in time: A flip book, for instance, is intended to be "processed" by flipping through its pages at a constant pace so as to simulate a motion picture.

Lastly, material types can also be defined by virtue of relationships. The whole-part relationship, for example, is built into our understanding of an anthology (the parts are components) or a monograph series (a collection of individual monographs). The parts may all be the same kind of thing (as is typically true with collections); alternatively, there may be a sense of subordination of one part to another (as with a teacher's guide that accompanies a textbook). Some material types, such as translations, transcriptions, adaptations, hypertext, etc., imply relationships.

5.3. Result

The preceding section has briefly discussed and illustrated seven facets used in characterizing material types; each facet combines two or more related attributes. This section gives the facet analysis itself (which is more suggestive of a fully faceted analysis than an instantiation thereof).

Content
- Subject matter
- Scope (e.g., high school yearbook)
  - Time period
  - Space
  - Organization
- Motivation (e.g., Festschrift)

Generation of content
- Authorship
  - Single
  - Multi-author, working together
  - Communal / social
- Fixity
  - Never changed
  - With discrete revisions
  - With continuous revisions
  - Never fixed

Recording of content
- Symbol system used
  - Language
  - Music
  - Pictorial
  - Machine code
- Method of recording
  - By hand (e.g., manuscript)
  - Electronic (e.g., electronic book)
  - Mechanical (e.g., printed book)
- When recorded

Publication / Distribution
- Manner of distribution
  - Distribution of physical medium
  - Electronic download
- Seriality; recurrence of publication
  - Serial
    - Regular
    - Irregular
  - Non-serial; punctual
- Quantity of publication run (e.g. limited edition)

Physical characteristics

- Type of material (not the same concept as material type!)
  - Bark
  - Paper
    - Cardboard
  - Parchment
  - Papyrus
- Quality of physical materials or data encoding (e.g., of paper, binding; resolution)
  - High
  - Average
  - Low
- Size of material object
  - Large
  - Average
  - Small
- Dimension
  - Three-dimensional
  - Two-dimensional
  - Non-dimensional
- Shape / manipulation
  - Flat (e.g. codex)
  - Folded (e.g. orihon, map)
  - Rolled up (e.g. scroll)
- Size of image
  - Reduced image
    - Microform
    - Miniature, but still eye-readable
  - Non-reduced; eye-readable
  - Enlarged (font size if text; % of original if not text)
- Quality of image
  - High (e.g., coffee table book quality)
  - Average
  - Low (e.g., commonplace book quality)

Perception / Use

- Sense used in perception
  - Vision (visual; e.g., paintings)
  - Hearing (audio; e.g., audio CDs)
  - Touch (tactile; e.g. Braille)

- Equipment needed for perception / use
  - None beyond human body (eyes, ears, hands)
  - Equipment to project visual images
  - Equipment to process digital data
    - Visual data (e.g., microfiche reader)
    - Textual data (e.g., computer [monitor])
    - Audio data (e.g., radio)
- Size of image
  - Reduced image
    - Microform
    - Miniature, but still eye-readable
  - Non-reduced; eye-readable
  - Enlarged (font size if text; % of original if not text)
- Occurrence in time
  - Dynamic (e.g., flip book vs. picture book)
    - Built into material
    - Under human control
      - Under operator control (e.g., projectionist)
      - Under user control (e.g., reader of pop-up book)
  - Static

Relationships

- Whole-part
  - Whole vs. part
  - Type (component; collection)
- Uniformity
  - All one thing
  - Combination (as of equals)
  - Accompanying (as of a subordinate)
- Relationship to other material types of same work
  - Parallel
    - Different registers
    - Different languages
    - Different keys
    - Different instruments
  - Adaptation, condensed
  - Adaptation, extended
- Isolatability
  - Standalone, self-contained work
  - Work references other works (e.g., hypertext; node-in-network)
  - Work depends on other works (e.g, review, translation)

5.4. Application

The faceted analysis just presented can be partially validated by applying it to several media types that have emerged within recent years. The characterization of blogs rests on several facets of this analysis: Blogs often focus on some particular subject matter; while they typically have a single primary author, they generally allow reader comments and so enjoy semi-communal authorship; blog content, which is typically textual, is continuously added to; it is recorded in machine-readable form, is distributed electronically, and thus requires computer equipment to read. While wikis and blogs share some characteristics, wikis differ from blogs in that the generation of their content is primarily communal in nature and in that their content is potentially under continuous revision (that is, continuous revision of content is more important to a wiki than continuous accumulation). It is left to the reader to decide whether these characterizations accurately capture the nature of blogs and wikis.

6. Conclusions

Although we often speak as if content and carrier are completely separable, this analysis has shown instead that they are inseparably connected. This has motivated an examination of material types, a concept intended to account for all but pure intellectual content.

The preliminary analysis undertaken here has revealed seven facets needed to characterize material types: content, generation of content, recording of content, publication/distribution, physical characteristics, perception/use, and relationships. This analysis will motivate the revised treatment of material types in the Dewey Decimal Classification. It is anticipated that a revision that starts from such an analysis will better accommodate new media that emerge in the future.

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Appendix

Here are listed, in alphabetical order, a representative sample of the material types that informed the data model in section 5.3.:

archival materials
art reproductions
audiovisual materials
board books
Braille
cartographic materials
charts
clippings
codices
coloring books
comic books
commonplace books
compact discs
computer files
digital publications
exhibition catalogs
Festschriften
filmstrips
globes
government publications
incunabula
kits
large-type publications
limited editions
manuscripts
maps
medical publishing
microforms
miniature books
motion pictures
music scores
newspapers
pamphlets
paperbacks
piano rolls
pictures
rare books
scrolls
serial publications
software
sound recordings
theses
web sites
yearbooks