Metadata About What? Distinguishing Between Ontic, Epistemic, and Documental Dimensions in Knowledge Organization†

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ABSTRACT: The spread of many new media and formats is changing the scenario faced by knowledge organizers: as printed monographs are not the only standard form of knowledge carrier anymore, the traditional kind of knowledge organization (KO) systems based on academic disciplines is put into question. A sounder foundation can be provided by an analysis of the different dimensions concurring to form the content of any knowledge item—what Brian Vickery described as the steps "from the world to the classifier." The ultimate referents of documents are the phenomena of the real world, that can be ordered by ontology, the study of what exists. Phenomena coexist in subjects with the perspectives by which they are considered, pertaining to epistemology, and with the formal features of knowledge carriers, adding a further, pragmatic layer. All these dimensions can be accounted for in metadata, but are often done so in mixed ways, making indexes less rigorous and interoperable. For example, while facet analysis was originally developed for subject indexing, many "faceted" interfaces today mix subject facets with form facets, and schemes presented as "ontologies" for the "semantic Web" also code for non-semantic information. In bibliographic classifications, phenomena are often confused with the disciplines dealing with them, the latter being assumed to be the most useful starting point, for users will have either one or another perspective. A general citation order of dimensions—phenomena, perspective, carrier—is recommended, helping to concentrate most relevant information at the beginning of headings.

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1.0 What is knowledge organization about?

For a long time, the most traditional form of indexing knowledge contents consisted of applying classification schemes and subject heading lists to printed books. However, new media have continuously appeared, the contents of which also needed to be organized: printed images, magnetic carriers, digital carriers, networked information, etc.

Beside this multiplication, we are now dealing with a convergence of media, through the universal language of digital formats, into integrated and diffused forms (cross-mediality): multimedia contents that easily pass from a mobile phone to a personal computer or a car navigator, interacting information devices in technologically equipped homes or retails, etc. (Resmini and Rosati 2008). The digital carriers are pushing libraries, archives, and museums to converge towards a common universal knowledge space (Rayward 1998), a trend confirmed by the increasing integration of cataloguing principles and schemes, such as FRBR or CIDOC-CRM, across library science, archive science, and museology. Knowledge organization (KO) is thus concerned not only with libraries, but with any collection of knowledge items including archived documents, natural specimens, and artifacts of any kind displayed in museums, galleries, and exhibitions, perhaps even organizations dealing with the subjects of interest (Gnoli 2010a; Latham 2012).

This situation poses new problems in identifying the boundaries of KO. If, for example, we state that KO deals with knowledge as recorded in documents, what should we consider as a document? The definition of notions like those of document, data, information, and knowledge is known to be difficult (Buckland 1997; Ridi 2010). Intuitively, we can say that a document is any carrier of information. However, as taught in semiotics, everything can convey information as it is interpreted as a sign of something other; the presence of a given plant can be interpreted as a sign that particular climatic conditions exist there which are necessary for the growth of that plant species. This would lead to the paradoxical conclusion that KO deals with everything.

Still, the domain can be restricted if we specify that conveyed information must have been intentionally put there to be interpreted by someone other. This rules out most plants, as they grow in a given place spontaneously, while only the plants intentionally put in a botanical garden to be displayed and illustrated by signs reporting their names are real documents. Which indeed makes botanical and zoological gardens, together with other kinds of exhibition, part of the scope of KO. In other words, as we are interested in subject contents, what matters is not the material object, but its use to convey knowledge.

2.0 The dimensions of knowledge organization

In 2007, I enjoyed the privilege of exchanging ideas about some general KO questions with Brian Vickery, an author whose work is recognized as central in the history of information science (Gnoli 2012). While discussing the role of disciplines and phenomena in classification, Vickery proposed this useful schema, later reported in a paper (Vickery 2010):

From the world to the classifier
- the world (nature, people, human artefacts) = phenomena
- people's activities = disciplines, fields of activity
- reports of activity, each within the viewpoint of its own discipline (field)
- subjects of reports and of topics within them
- classification of subjects—which will need both disciplinary and phenomenal aspects

The schema makes clear how knowledge moves through a series of layers. The series originates in the real world, that pre-exists to knowledge and provides its objects. Real phenomena are studied by humans through their epistemic activities. These are structured according to various categories, including traditional disciplines. Documents can then be seen as reports about these epistemic activities, hence their content will include both structures of the original objects and structures of the activities by which they are investigated. Paul Otlet was a pioneer in acknowledging this more than one century ago, when he wrote that a classification "should enumerate both the objects and the points of view and choose as the basis of classification a sequence of one or the other as needs be" (Otlet 1990, 64).

To the features of the two previous layers, documents, in turn, add those of their own, like their format, length, or material. All these layers thus become part of the subjects that have to be identified and analyzed in classification (or, more in general, in KO). In other words, the reference of indexing terms and notations to reality is an indirect one through the mediation of documents (Hutchins 1975, 32-33).

I will call all these layers the dimensions of knowledge organization, following the use of this word by

Tennis (2002) and Hjørland and Hartel (2003). Such a term expresses the fact that they are separate structures, all together concurring to form the subject of a document. The mathematical meaning of the term also suggests that the coexistence of several dimensions can be addressed by an analytico-synthetic approach, in which each knowledge item is ideally placed in a multi-dimensional space at the crossing of the coordinates for each dimension. Indeed, the analytico-synthetic model introduced in KO with facet analysis has been described as "multidimensional" (Gatto 2006). Notice, however, that in our model, facets themselves are to be identified only within each dimension: hence we will have the facets of phenomena, the facets of epistemic activities, etc.

Vickery's scheme can be reformulated and extended in the following table, where each dimension is represented by a term, a corresponding field of study, and a symbol (a Greek letter, thus avoiding confusion with most KOS notations):

α	(reality)	[mystique?]
β	phenomena	[ontology]
γ	perspectives	[epistemology]
δ	carriers	[bibliology]
ε	collections	[library science]
ζ	users	[sociology]

The next sections will consider the dimensions listed above in more depth, with special focus on dimensions β, γ, and δ.

3.0 The ontic dimension

Reality in itself (α)—what Kant called the *noumenon*—is perceived by humans only indirectly, through their sense organs and intellectual apparatus (with the possible exception of mystic knowledge, which we will not further discuss here).

Thus the actual basis on which KO can operate are the perceived phenomena (β): photons, granites, cats, teams, operas, etc. The term "phenomena" is adopted by various authors in KO literature (Mills and Broughton 1977, 49; Beghtol 1998; Szostak 2004, 30; Szostak 2007), although Dahlberg (2008) finds it misleading and prefers "general objects." The identification and ordering of phenomena is the task of ontology, the study of what exists, now increasingly applied to the organization of digital knowledge. Phenomena are often opposed to the disciplines studying them, as an alternative starting point for the organization of knowledge, especially in general classifications (Mills and Broughton 1977, 55): we can choose whether to first consider the phenomenon "stars" or the discipline "Arabian astrology" that studies it under a particular perspective.

Many disciplines can be described as the scientific study of a given class of phenomena, like astronomy is the study of stars, botany is the study of plants, etc. However, for Mills and Broughton, these are only "sub-disciplines" of a smaller number of "fundamental disciplines," like science, philosophy, history, and art, which can be defined in epistemic terms, as alternative "ways of looking at the phenomena of the world;" history could then study everything in a chronological perspective, art could represent everything in creative forms, etc.

While disciplines are traditionally adopted for the organization of printed books, it can be difficult to apply them to the greater variety of contemporary media. In this sense, phenomena offer a more generalizable basis that can be shared between very different media (Gnoli 2010a), because, as is shown in our scheme, they are a more fundamental dimension of knowledge: an Arabic parchment, a documentary film, and a planetarium presentation can all refer ultimately to "stars." In the words of librarian Douglas Foskett (1970, 45): "reality is the basis for the texts of documents; that is what authors try to describe, and what searchers are investigating." More recently, philosopher and computer scientist Barry Smith stated similarly that ontologies are concerned with "building models of entities in reality, thus for example building models of the organization of the genome and not just of *information* contained in this or that database" (Smith 2004, 77 emphasis his).

Of course, the ways in which reality is analyzed into distinct concepts depend on the current advancement of knowledge; concepts like "aether" or "phlogiston," although originally intended to denote real phenomena, have subsequently been found to be inappropriate and abandoned, while other concepts have changed in meaning as knowledge progressed (LaPorte 2004). The consequence of this for KO is that KOSs will always need to be updated. Even the ontic dimension of knowledge depends both on reality and on theories about it (Popper 1972). The extent at which theories determine concepts is widely debated in philosophy. Still, given a certain stage of development in knowledge, phenomena can be conceived as entities separate from the ways to study them.

4.0 The epistemic dimension

Phenomena coexist in subjects with the material and intellectual means by which they are considered: microscopy techniques, semiotics, Marxism, poetry, education of children, etc. These include the disciplines, as discussed above, but also the domains addressed by different research communities (Hjørland 1995), the human activities to which knowledge is intended to be applied (Vickery 2008), the communicative functions performed in transmitting knowledge (Hutchins 1976, 8), the theories adopted and methods applied (Szostak 2007), the historical epoch and geographical context in which knowledge is produced (Tennis 2002), and, in general, all viewpoints adopted by authors (Beghtol 2002).

In our scheme, we have subsumed all these under the label of perspective; this term, as well as others like aspect, viewpoint, or bias, have been used to describe KOSs that organize not phenomena directly, but rather ways of looking at them (Langridge 1992, 6-10; Svenonius 1997; 2000; Slavić 2007). Perspectives can be studied by epistemology, the science of the ways and means by which knowledge is acquired.

A faceted classification able to distinguish between different knowledge dimensions, like the Integrative Levels Classification (ILC) (Gnoli et al. 2008), may represent all the kinds of approaches mentioned above as facets of the epistemic dimension, as opposed to facets of the ontic dimension. In ILC, facets of the epistemic dimension begins by the digit 0 and are listed in the following table:

0	perspective	
01		epoch
02		place
03		method
04		theory
05		discipline
06		culture
07		activity field, domain
08		modality
09		communicative function

It can be noticed that, while in many documents, phenomena are the primary object of treatment, particular kinds of documents exist in which phenomena are less important as compared to perspective: that is, it is not very important what is represented, but how it is represented. Examples of this are poetry and other forms of art, in which very different objects can be represented to convey one same message, like sadness or nationalism, and political cartoons, where the represented phenomena are often allegories expressing a political judgment rather than the actual details shown (Landbeck 2008).

5.0 The documental dimension

A third relevant dimension in our present analysis is given by the formal features of knowledge carriers: videos, MPEG formats, dates of production, durations, document sizes, etc. These contribute the subject matter of documents with a layer δ that, although less basic than those of phenomena and perspectives, may nevertheless get some relevance.

ILC analyzes this dimension into the following documental facets, beginning with 00:

00	document	
001		publication time
002		publication place
003		language
004		medium
005		section
006		author
007		target
008		commented document
009		format

Like with perspectives, carriers also get special importance in some kinds of documents that are strongly formal. This is the case with abstract paintings or instrumental music, which can hardly been said to represent any specific phenomenon. Exceptions are still possible, like Bedřich Smetana's *The Moldau*, an instrumental symphonic poem that explicitly refers to an actual river (phenomenon), with music imitating the flow of the river in its various stretches, and more implicitly to the ideal of Bohemian national identity (perspective).

Further, pragmatic layers concerning the storing and circulation of knowledge contents can be identified, like those of the particular collection in which a document is kept together with others, or the particular community of users that interact with it. However, we will not consider these dimensions in detail here.

6.0 Representing the dimensions

The three dimensions that we have discussed in detail manifest themselves in actual documents in various ways. Ranganathan wrote that a book has a mind (the phenomena it deals with), a language (the perspective

adopted in doing so), and a body (its material carrier) (Ranganathan 1967). In metadata, dimensions can be combined more or less explicitly; consider such titles as "Handbook [carrier] of African antropology [phenomena + perspective]," "Lectures [carrier] on set [phenomena] theory [perspective]," "Bird [phenomenon]-watching [perspective] in the Cotentin peninsula [phenomenon]: a guide [carrier]."

In informal communication, like e-mail subjects or webpage titles, carriers and perspectives are often provided without reflection as the first or even the only knowledge element: "Information on ...," "Question." Clearly, such metadata are much less useful than if phenomena were given precedence and used as main labels.

The latter strategy would correspond more closely to what is taught in many handbooks of subject indexing, which recommend to leave formal specifications, such as "guide," at the end of compound strings. A similar principle is used in classified shelfmarks, where metadata belonging to the documental dimension, such as date of publication or initials of the first author, are expressed (if at all) only after the symbols for the basic subject content (perspective + phenomena). In many cases, indeed, the most relevant information—also called the main theme in subject indexing (Buizza 2011; Gnoli 2010b)—is what a document is about, while its approach and form are only complementary specifications.

It is not by chance that digital interfaces using resizable windows, like Web browsers, when fed with a string of metadata longer than the available space, are programmed to display its beginning rather than its end. Therefore, for the purposes of information architecture, a principle of front loading has to be recommended, consisting in concentrating the most relevant information towards the beginning of a string.

In general, a recommendable standard citation order between dimensions is:

phenomena > perspective > carrier

As we have seen, classical bibliographic classifications reverse the first two dimensions by taking disciplines as their first divisions. This is, in itself, a perfectly legitimate alternative, whose efficiency could be tested and compared. Comparison would need that the distinction between phenomena and perspectives were clear, as is also recommended by Svenonius (1997, 16). However, disciplinary classifications can mix these two dimensions in shaded ways. UDC class 59 codes for the discipline "zoology," while its subclasses have captions with nouns of phenomena, like 599 "mammalia, mammals." In the faceted perspective now adopted in UDC, subclasses like "mammals" are interpreted as the first facet of zoology, belonging to the general category of Things, although not separated from the discipline class in the notational plane. Distinction between discipline and phenomenon can result in benefits for machine treatment.

Confusion between dimensions can be observed in many information resources and tools. The application of facet analysis to Web information architecture has enjoyed much success in last years (La Barre 2004), having recently been adopted even in Google search results. However, what information architects call "facets" are often facets of the documental dimension, such as date, size, or language, which are easier to obtain and to treat automatically, while the original notion of facet was developed in library classification with reference to the more substantive facets of the ontic and epistemic dimensions, such as part, process, or agent.

This confusion seems to be spreading in metadata terminology too. The development of ontologies and the very notion of a semantic Web have arisen just in response to the lack of tools to organize and connect digital contents by their subject matter, while tools for managing descriptive metadata—such as the Dublin Core elements set—already existed. However, the success of the new tools is now reflected in calling "semantic" even metadata for descriptive indexing, including "ontologies" for description of documents by authors, title, date, etc. Again, it seems that a clearer distinction between the dimensions identified in this paper will be increasingly useful.

To summarize, our general thesis is that there is a need for distinguishing between the different dimensions of knowledge items and for treating each dimension separately in an appropriate way. This thesis agrees with the five recommendations of the León Manifesto (ISKO Italia 2007):

> The current trend towards an increasing interdisciplinarity of knowledge calls for essentially new KOSs ...
>
> this innovation is ... feasible
>
> instead of disciplines, the basic units of the new KOS should be phenomena ...
>
> the new KOS should allow users to shift from one perspective or viewpoint to another ...
>
> the connections ... can be expressed and managed by analytico-synthetic techniques.

These requirements are being implemented in the experimental ILC system. As reported above, all facets conveying information on perspective and on carrier, as opposed to phenomena, can be identified in ILC by their facet indicators. This allows for parsing phenomena, perspectives, and carriers as separate dimensions in compound classmarks, and for their automatic treatment in digital applications—e.g., displaying each dimension in a different font, displaying only some dimensions, displaying dimensions in alternative citation orders, search and extract only items with a given phenomenon, or perspective, or carrier independently from the other dimensions.

ILC perspective facets are especially tested in the BioAcoustic Reference Database, a classified bibliography where facets of scientific method are often relevant (e.g., "harbour porpoises, nervous system, studied by magnetic resonance") (Gnoli et al. 2008).

7.0 Concluding remarks

Traditional KOSs that mix more than one dimension into simpler headings, like disciplinary classifications, do so under the assumption of literary warrant: if documents have been produced by their authors with some perspective and form, they will be useful to users adopting the same perspective and working with the same forms—say, only users working in the domain of zoology or only users working with online resources. This approach reflects a conception of the task of KO as limited to the representation of available sources in a faithful way. It tends to produce conservative applications: research communities will continue to read and cite only themselves, without taking advantage of what has been done by applying other perspectives or other carriers to the same phenomena, or by considering other phenomena by the same perspective, etc. (Szostak 2007).

However, one can also conceive that KO do more than just keeping the status-quo of knowledge; it could also highlight previously unnoticed connections between existing knowledge that will stimulate further research (Davies 1989). In order to enable the creation of new knowledge across different domains, disciplinary schemes should be replaced by more flexible structures (Jacob 1994).

This seems to be possible only if the different dimensions of subject matters are analyzed, identified, and represented separately so that each one can be searched and retrieved alone and creatively associated with others. While perspectives and carriers can provide important specifications and sometimes even become the main theme, the most universal knowledge units, on which an analytico-synthetic KOS should be based, are phenomena.

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