Are traditions of facet theory geographically bounded or transcendent?

Kathryn La Barre
University of Illinois, 503 E. Daniel Street, MC-493, Champaign, IL 61820, USA
klabarre@illinois.edu

Abstract
By drawing on a variety of sources, including personal correspondence with Brian Vickery, this paper draws upon a socio-historical approach in order to provide a platform for continued conversations among facet theorists and those who seek to create faceted applications. Once common ground is established, it is but a small step to the creation of operational definitions and functional requirements as Slavic (2008) and others have discussed. With variant terminology under control, facet theorists can move quickly to identify and promote exemplars of best practice for those seeking to implement facets as search and discovery structures in contemporary information spaces.
Keywords: Facet theory, Facet analysis, Functional requirements, Operational definitions.

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1. PREFACE

What does it mean to speak of tradition? Tradition, as commonly considered, encompasses both legal and ritual aspects, while evoking notions of custom, culture, and praxis. Tradition often refers to the formal or legal act of conveyance or exchange of long-established practices or to continuing or customary patterns of beliefs, practices, methods or doctrines. Invoking the concept of tradition often implies some form of intergenerational transmission of ceremony or knowledge (Wordnet, 2011). Tradition commonly invokes a sense of belonging for members of a given community. It can also be wielded as an exclusionary barrier to make outsiders feel alien or foreign.

How much change is permissible within a given tradition over time? Opinions differ widely about the role of evolution. Some may seek to preserve tradition with absolute fidelity and stasis. Others find succor in a mutable and dynamic tradition as signaling a heritage that will prove to be durable and long-lived. Can it be said that the existence of divergent understandings is a primary indicator of the existence of different traditions or is the reality far more nuanced? This paper examines this question in the context of several pivot points, including the use of 'facets' in Next Generation Catalogs and Semantic Web implementations. It concludes with a call for the creation of operational definitions and functional requirements for facet theory that may serve to enhance, amplify or extend current understandings and practices.

2. BACKGROUND

In this context we are primarily concerned with the tradition that encompasses a set of heritage theories and practices in the area of knowledge organization known as the faceted analytical tradition. The most well known exemplars from this tradition are exemplified by S.R Ranganathan's *Colon Classification* and his technique of *facet analysis* (Ranganathan, 1933). Other examples of Faceted Classification include the *Universal Decimal Classification* (Pollard, 1926) and the *Bliss Classification* (Bliss, 1929). As with many traditions, facet theory has an established canon of literature and a set of normative principles and postulates (Ranganathan, 1967).

Broughton (2006) and others make references to a British tradition of facet theory, distinguishing it from that found in the USA. Some researchers also point to the existence of an Indian tradition that more closely follows Ranganathan's explication of facet theory. There may be others - is there, for example, a Spanish tradition of facet theory somehow distinguishable from these three?

During the early 1950s three international groups, the British Classification Research Group (CRG), the North American Classification Research Study Group (CRSG), and the Indian Library Research Circle (LRC) worked tirelessly to promote and experiment with S.R. Ranganathan's (1937/1957) facet theory (Brownson, 1960; Classification Research Group, 1955; La Barre, 2004; Parthasarathy, 1952; Ranganathan, 1937/1957, Ranganathan, 1962). The British CRG has remained the most active of the three groups. Few would

disagree that the core literary canon is largely composed of the works created by members of the CRG (e.g. Binns and Bagley, 1958/1961; Classification Research Group, 1955; Foskett, 1957; Mills, 1957; Vicker, 1960). More contemporary works from members of this group are also part of the canon (e.g. Broughton, 2006; Mills, 2004; Vickery, 2008). Works created by members of the other groups are also part of the canon, but are less often referenced (by the LRC members: e.g. Devadason, 2009; Gopinath, 1986, Neelameghan, 1992; Neelameghan and Gopinath, 1975, by the CRSG members: e.g. Anderson, 1980; Atherton, 1965; Richmond, 1981).

3. A GARDEN OF FORKING PATHS?

This web of time — the strands of which approach one another, bifurcate, intersect or ignore each other through the centuries — embraces every possibility (Borges, p. 98).

This quotation from Borges describes a *Garden of Forking Paths* and we find a similar pattern in the trajectory of facet theory. Although Ranganathan and the British Classification Research Group initially used the terminology of facet theory in a precise fashion, variant understandings began to multiply over the intervening fifty-five years. Eric de Grolier (1962), a French classification theorist, astutely observed divergent term use even among British Classification Research Group members. For example, he noted that D.J. Foskett, among others, frequently interchanged the terms *category* and *facet.* In the same vein, Foskett commonly described facet analysis as '…analysis of a subject in its entirety into a certain number of … categories of things.'

By 1960, Vickery and others commonly substituted the phrase *conceptual categories* 'of high generality and application that can be used to group other concepts' for the term *fundamental categories* preferred by Ranganathan. Attributing these divergences to 'Ranganathian language,' de Grolier described the "use of the extremely specialized term *fundamental categorie*s to reference each facet of a subject, as well as each division of a facet" as a locus of confusion (Grolier, 1962, p. 15).

Some of the differences in vocabulary and understanding may spring from the geographical and cultural separation of the three research groups that promoted facets as document retrieval devices in the 1950s, (the LRC in India, the CRSG in Britain, and the North American CRSG). Regardless of source, terminological and practical confusion is now rampant (La Barre, 2010).

4. VARIANT UNDERSTANDINGS: HERITAGE

The term *facet* is often used interchangeably with terms such as category, attribute, class, group, concept and dimension in both heritage and contemporary literature (La Barre, 2010). Ranganathan first used the phrase *train of characteristics* instead of the term *facet* to emphasize the inherent nature of characteristics in subjects (or entities) (Ranganathan, 1967, pp. 81-82). For Ranganathan, the notion of facet springs from the mathematical

concept of *parameter* that presents a range of possible factors, aspects or elements. It is these factors, aspects or elements that permit the identification of a distinct set of cases. Each grouping represents a facet. Each facet (or grouping of characteristics) has the potential to include multiple dimensions of a given parameter (Ranganathan, 1967). To further cloud the waters, each facet can exist as a recursive or linguistically nested structure.

To fully grasp the concept of facet one must understand that facets are derived through an iterative technique called *facet analysis* – which relies on a set of fundamental categories. Ranganathan postulated the existence of five *fundamental categories*, personality, matter, energy, space, and time. For Ranganathan, *fundamental categories* assist in the "mapping of a universe of subjects in a helpful sequence." He allows for the possible existence of more than five fundamental categories after sufficient experimentation. Ranganathan (1967, p. 398) refrains from an exact definition of the term *fundamental categories,* and instead directs attention to the identification of isolate ideas, which represent manifestations of the underlying fundamental category. Somewhat confusingly, Ranganathan also used the term *basic facet* when discussing his five *fundamental categories*. Thus an item with the title "Coal washing" would have the subject *Mining* as its basic facet, and two fundamental categories that are isolates of the basic facet: *Coal* (Personality facet) and *Washing* (Energy facet). The *basic facet* device has resulted in a fair bit of confusion over time.

Vickery describes Ranganathan's *fundamental categories* as follows:

> Ranganathan, working within an Indian rather than Western tradition, considered that each subject category could be regarded as a "manifestation" of one of a set of "fundamental categories" that to him were basic (Personality, Matter, Energy, Space, Time). As his classification expanded, he found the need to use second and even third "levels" of Personality, and several "rounds" of Energy, to accommodate the actual facets that he recognised in various subject fields; and eventually the further fundamental category of Property was added (Vickery, 2005).

By 1960, the CRG developed a more refined sense of the role of *fundamental categories* than was most fully articulated by Ranganathan in the fourth edition of the *Colon Classification* (Ranganathan, 1952).

Emphasizing their provisional nature, the CRG urged that *fundamental categories* "should not be used mechanically and imposed upon the subject, but … as a provisional guide in approaching a new field … as an outline framework which may fit the field and give guidance in suggesting possible characteristics which should not be overlooked" (Vickery, 1960, p. 24).

Another product of CRG experimentation with facet theory was an expansion, beyond five, of the number of fundamental categories. Over time CRG proposed several lists of fundamental categories that had proven useful in the construction of a number of specialized schemes. This list today is best summarized by Aitchison née Binns, Gilchrist and Bawden (2002, p. 71):

1. Entities, things and objects subdivided by characteristics and functions
2. Actions and Activities
3. Time
4. Kinds or types; systems and assemblies; applications and purposes

Vickery explains this development as follows:

> The Western tradition of *fundamental categories*, found it more helpful to use categories closer to the Aristotelian categories, and used a 'standard' set ... more closely related to those of Aristotle ... often cited as: thing, kind, part, property, material, process, operation, agent, patient, product, by-product, space and time ... The 'standard set' was mainly derived from the experience of analysing science/technology subject fields, and has not been found wholly suitable in the facet analysis of the humanities (Vickery, 2005).

With a provisional set of *fundamental categories* in hand, the next step is to use them in the technique of *facet analysis* which is "the sorting of terms...into homogeneous, mutually exclusive facets each derived from the parent universe by a single characteristic of division." In other words, Vickery (1960, p. 12) advises "we may look upon facets as groups of terms derived by taking each term and defining it *per genus et differentiam*, with respect to its parent class."

Mills, an original member of the CRG, and editor of the 2nd edition of the Bliss Classification, notes that facet analysis essentially results in the assignment of terms to two types of facets (Mills, 2004, p. 551):

> (1) True categories: e.g. geographical location, chronological time, material of composition
> (2) Relational categories: e.g. kind, part or property

Another divergence of understanding emerged during Vickery's (2005) correspondence with the author. Vickery stated, that in his understanding, the term *fundamental category* denotes "a general type of facet, a principle 'manifested' by the facet." He finds Mills' distinction (above) confusing. "Mills is cited as distinguishing between two types of facet: basic (true) and relational.

I was not aware of this distinction and do not understand it." At the same time, Vickery discussed the role of facet analysis as a way of representing document subjects, and by extension, faceted classification as a way to arrange the resulting representations is a way that "facilitates search of the collection for one particular subject. "Ranganathan was the first to explicitly use the idea of categories as a representation of subjects, with subject fields forming the basic classes." (Vickery, 2005).

This is a simple description of facet analysis and the creation of a faceted classification in Vickery's words:

> Ranganathan surveyed words used in a particular subject field, and assigned each of them to a category. Pairs of words that were synonymous would both be assigned to a single preferred term. The set of terms assigned to a particular category he called a "facet", and the resulting set of facets may be called a "schedule". The subject of a document could be translated from natural language by combining terms from two or more facets according to a set of syntactical rules. To create a classification, each subject field, facet and term within it was assigned an alphanumerical tag to indicate its position, so that a faceted subject representation was itself represented as a 'class number' (Vickery, 2005).

Mills (2004) more formally describes the series of design steps that guide the process of identifying facets using the technique of facet analysis and the eventual creation of a faceted classification:

> (1) Division of the subject into broad facets (categories);
> (2) Division of each facet into specific subfacets (usually called arrays, following Ranganathan);
> (3) Deciding the citation order between facets and between arrays;
> (4) Deciding the filing order between facets and between arrays and the order of classes within each array;
> (5) Adding a notation;
> (6) Adding an A/Z index.

Vickery agrees with Mills that the first two steps outlined above are in accord with the principle of logical division, one characteristic of division applied at one time, steps in division should be proximate, and exhaustive - while noting critically important differences in the strictness with which the rules of logical division are applied in facet analysis where every distinctive category should be isolated, every new characteristic of division should be clearly formulated, every new relation should be recognized (Vickery, 1960, p. 13; Mills, 2004, 550). This results in a classification that allows full combinatorial freedom for facets, and greater expressivity for concept relations. Lastly by breaking free of the traditional rigidity of enumerative classification, new logical relations can be formed (Vickery, 1960, p. 13).

5. VARIANT UNDERSTANDINGS: CONTEMPORARY

This is a complex tradition, with several diverging and overlapping paths. We now turn to contemporary understandings of facet theory. For developers who experiment with facet theory outside the confines of LIS, understanding and application of facet theory evinces even greater variability than traditional understandings and applications. In the United States the term *facets* as used by Information Architects (La Barre, 2006) and in some Next

Generation Catalogs (La Barre, 2010), more closely resemble ad hoc categories and often bear faint resemblance to facets created through the process of facet analysis.

Some Web developers consider any information organization system with elements of synthesis to be a Faceted Classification and many Information Architects loosely refer to the use of faceted access structures for objects as 'Faceted Classification'. Here, some members of the British tradition of facet theory draw a sharp distinction - Faceted Classification is applied to subjects, not objects. Other differences in understanding relate to whether or not elements of a faceted navigation display can properly be considered fundamental categories, or something else entirely – such as principles of division.

Emblematic of this contentious situation, the OCLC research project FAST (Faceted Access to Subject Terminology) was an attempt to simplify the Library of Congress Subject Headings (LCSH) and reduce the cost of indexing of bibliographic and other material. The FAST schema has eight facets: Personal names, Corporate names, Geographic names, Events, Titles, Time periods, Topics, and Form/Genre. This "simplified syntax ... retains the very rich vocabulary of LCSH while making the schema easier to understand, control, apply, and use... [A]ny valid set of LC subject headings can be converted to FAST headings" (OCLC FAST website).

Although some may discern uniformity in the North American tradition of facet theory, many North American researchers readily agree with Broughton's contention that FAST "makes some progress along the road to consistent analytico-synthesis, although it is not faceted in the sense that most UK professionals would recognise" (Broughton, 2006, p. 58). Many also concur with Broughton's assessment that the NISO Z39.19 definition of facet as "attributes of content objects encompassing various non-semantic aspects of a document" and listing of facets [such as] "topic, author, location, format, language, and place of publication" has more in common with database fields than traditional facets (Broughton, 2006, p. 58). Broughton is quite correct when she observes that this "has a great deal in common with the FAST project ... where "topic" (or subject) is regarded as one facet among a list of non-subject elements of bibliographic description." Even though some North American researchers might consider these to be equivalent to "fundamental categories," many would instead recognize their genesis in MARC and Dublin Core fields, not as actual or necessarily appropriate products of rigorous facet analysis.

This superficial notion of facet (akin to leveraging existing data fields) also appears in many Next Generation Catalogs for bibliographic holdings in libraries. It is clear that facet analysis has yet to become a standard part of OPAC system design. While the practices embedded in most Next Generation Catalogs may be unique to the United States, this situation is not an indicator of unanimity in understanding. Rather, it is an expediency eagerly grasped by a few OPAC software designers. Few North American facet theorists would disagree with the statement that the true strength of facet analysis lies in the way it can "peel the onion of an idea" (Vickery, 1966, p. 13-14). Too often, concerns about time and money work against deep subject analysis that could be most fully displayed in the context of an OPAC display designed to fully leverage facets.

A recent exchange with a member of the Indian school revealed more finely nuanced differences in understanding (Raghavan, personal communication, 2010). For Raghavan, "a

facet is just one aspect of a multidimensional subject or an attribute of a physical carrier." The distinction continues further in that some members of the British tradition differentiate between subject-facets and object-facets. Raghavan's (2010) view of this follows:

> I do not see any fundamental difference in these two senses. However, I tend to disagree slightly with this approach. To me a facet is merely a component / face / one aspect of a multidimensional subject. In object classification a facet also refers to attributes of the (physical) carrier / container of knowledge.
> In library classification, we deal with both objects and knowledge (subject). For example, the style of presentation, form or target audience of a document is not necessarily a component of the subject. Nevertheless we may need to identify these facets of the object and provide for their handling in document representations. These have become more complex with electronic resources which necessitate handling a range of attributes (facets) of these documents such as form, file format, etc).

He goes on to make an even higher-level distinction (Raghavan, 2010):

> I would like, however, to make a fundamental distinction between 'facets' and (fundamental / elementary / primitive) categories. Categories are at a higher level and are arrived at by a process of 'logical abstraction'. The nature and number of categories would, according to some, depend on the purpose, while for some others it is possible to arrive at a set of fundamental categories that are applicable to all branches of knowledge (universals). The CRG adopted the second approach in identifying and defining the 'categories' ... in their development of special faceted classification schemes.
> [O]ne gets the feeling that subsequent researchers,… sought 'universals' (fundamental categories) applicable across disciplines. Ranganathan, from the very beginning, has emphasized the need for 'universals' (fundamental categories) in his approach to designing faceted classification. This is a matter that could be debated, but I guess we are increasingly beginning to recognize the importance of 'universals' - even if we do not agree with [Ranganathan's].
> In other words we try to identify all the different facets that occur or likely to occur in a domain / discipline and try to group these together based on what they represent (the process of logical abstraction). The labels that we assign to these groups are / could be called 'categories'. Every facet is derivable from the category to which it belongs via a process of division using 'characteristics of division'. A subject (say, the subject of a doctoral thesis) can have any number of facets; but all these facets are manifestations of one of the 'categories'.

Thus it would seem that agreed upon operational definitions for central concepts of facet theory, such as facet and fundamental category would seem to be an urgent requirement. The following section discusses a secondary approach, the formation of functional requirements for facet analysis.

6. FUNCTIONAL REQUIREMENTS: FACET ANALYSIS

In 2003, Phil Murray indicated that one motivation for the formation of the Faceted Classification listserv was his interest in expanding upon his preliminary set of functional requirements for facet theory (Murray, 2003):

1. What is the most effective way to model the process of facet analysis?
2. Is there a recognized way to design and model Faceted Classification?
3. How should a human or a machine index with facets?
4. What interchange formats are best for capturing facets and facet relations?
5. What software or metadata tools are best for faceted implementations and applications?
6. What is the best approach to selecting automated categorization tools for sharing schemas, supporting facets?
7. What approaches are similar to Faceted Classification or facet analysis?

These need refinement, but are a good start to a process of identifying mission critical features and functional requirements that are accessible for those who would seek to use facet theory. Slavic, who motivated the post by Murray, has also proposed the importance of agreed-upon functional requirements in support of online faceted classifications to better assist in maintenance and management, the creation of indexing tools, and as a way to "improve standards for the use and exchange of knowledge organization systems" (Slavic, 2008, p. 258).

Other preliminary attempts to identify functional requirements reside in unexpected places. One source is Kashyap's comparison of Ranganathan's facet postulates and principles to Chen's entity-relationship modeling. The analysis here helps bridge the understanding barrier between facet theorists and those working in cognate traditions (Kashyap, 2001).

While considering functional requirements, it would be useful to weigh the role of facet analysis in ontology development. Broughton has identified shared and complementary roles for facets in ontology building. Both provide excellent vocabulary control structures, support term disambiguation, enhance browsing and searching, and can be used to build a site navigation frameworks. This is true primarily because Faceted Classifications rely upon the use of mathematically based formal coding to express content and content element relations, with the result that the notation and facet indicators can be leveraged by search and access systems. This use of formal coding has the potential to enable manipulation and integration or conversion of a Faceted Classification into a fully developed ontology (Broughton, 2006, p. 65-66).

To take this line of reasoning a bit further, because facets represent aspects or viewpoints from which an entity may be analyzed, Sigel (2003) and others promote the use of facet analysis of concepts into basic categories, not simply because it is an efficient way to identify the central concepts in a domain, or to make explicit all essential aspects of a concept, but because it can also uncover the relationships between concepts in a domain (Foskett, 1977; Sigel, 2003, p. 405; Soergel, 1985, p. 257, 280; Vickery, 1966). Because of this robust

mutability, Sigel observes that facet analysis can also support semantic factoring, or analysis of categories into primitives or basic level concepts at any level of an ontology.

Soergel views semantic factoring as an equivalent process to facet analysis. He envisions the stepwise process of semantic factoring as a facet framework. If one conceives of each facet as a question, each answer thus represents one essential aspect of a given concept. This functional approach is demonstrated by the following example (Soergel, 1985, p. 258)

> Of which class is the concept or object a member or subclass?
> Is the object in a specific state, condition or circumstance?
> What is it capable of doing? Does it have a specific purpose?
> Does the object or concept cause, influence, produce or act upon another?
> Is X a means by which to achieve something else?
> Is it a theory or aspect? Is it a specific aspect or viewpoint?
> Is it accompanied by something or does it accompany something?

This echoes heritage understandings as reflected by Vickery's (1966) encouragement to ask a series of questions during the process of facet analysis: What concept does this represent? In what conceptual category should this concept be included? What are the class relations between this concept and other concepts included in the same category?

Given such a framework of analysis, might it be possible to embed this approach in a set of functional requirements for use in the creation of formalized knowledge representations (such as a set of IF-THEN rules) for use in a semi-automated routine designed to assist with ontology creation.

John Sowa (undated) provides support for this musing with an observation that "the techniques of semantic factoring can be applied to any level of an ontology from the highest, most general concept types to the lowest, most specialized types. The methods can be automated, as in formal concept analysis, which is a systematic technique for deriving a lattice of concept types from low-level data about individual instances." Building on this suggestion, Uta Priss (2008) presented a mathematical model for facets that utilizes Formal Concept Analysis (FCA) to support the creation of graphical representations of faceted systems. Might such an approach potentially serve as a functional model for formalized facet analysis as well? Both Priss and Sowa reference Wille (1992) as a fundamental source for understanding FCA, and a potentially fruitful area for those interested in promoting and extending the use of facet theory for ontology development.

7. CONCLUSION

Facet theorists must work to find common ground, and to regularize term use wherever practicable. Once freed from the reigning confusion, attention can be directed to promoting facet theory among researchers in cognate areas. As such, it may be useful to operationalize agreed-upon definitions and begin work on a set of functional requirements for facet

analysis. Both deliverables are potentially useful to researchers hard at work creating formal representations of facet analytical approaches and those who seek to create robust and theoretically grounded Semantic (Faceted) Web applications (La Barre, 2011). This paper is a call to those who are interested in engaging in this discussion. This same conversation is being extended to participants of the upcoming NASKO conference in June of 2011, and the ISKO UK conference in July of 2012. I hope that once begun, the participants of the Tenth ISKO Spain conference will join in the discussions at the next ISKO meeting in 2012, to be held in Bangalore India, home to Ranganathan's Documentation Research and Training Centre.

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