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## Faceted classification as the basis of all information retrieval

**Abstract:** The Classification Research Group manifesto of 1955 proclaimed its members' commitment to the techniques of facet analysis as a general methodology for organizational, indexing and retrieval systems. In the 1950s this was hardly the case, but sixty years later the influence of faceted classification can be seen in all kinds of representation and discovery tools, and goes far beyond the limits of the conventional bibliographic classification that many of the original CRG envisaged as their objective. However, the CRG's purpose was not just to encourage the faceted approach to designing and constructing classifications, but to propose it as a fundamental theory of knowledge organization, at the core of the disciplines of library and information science. At the time faceted classification theory was in many respects poorly articulated; many of the elements of 'classical' facet analysis were yet to be properly identified and defined, and it would be the work of some years to arrive at a mature theory. Yet that rudimentary model would eventually provide a foundation for much modern information retrieval. What are the distinctive features of facet analysis that make it so compatible with current needs, particularly in a digital environment? Some of the truth resides in the integrated nature of the faceted model, its clear explication of categorization, order, and intra- and inter-facet relationships, which can be rolled out across different species of knowledge organization system. The logic of this structures is readily exploited in automated systems, and can in part be expressed by representation languages. The complexity of the fully faceted classification, while internally consistent, is, nevertheless, challenging to realise in the same way.

**Keywords:** faceted classification; information retrieval; classification theory

### 1. Introduction

In 1955 the recently formed Classification Research Group issued what is commonly referred to as their manifesto, in which they proclaimed their purpose to make 'faceted classification the basis of all information retrieval' (Classification Research Group, 1955: 262). In examining the work of the CRG and of Ranganathan's ideas which largely informed it, three questions suggest themselves: what was the relationship between classification and information retrieval, and was there a conflict between them; is facet analysis a theory of information, or simply a robust and powerful methodology for constructing knowledge organization and retrieval systems; and, if facet analysis is a theory, what is its conceptual framework?

### 2. The origins of the Classification Research Group

The immediate context of the group was the decision of the 1948 Royal Society Conference on Scientific Information (Royal Society, 1948) to establish a committee to look into the documentation and dissemination of scientific information in Great Britain, the poor conduct of which, it was felt, was holding back scientific research in this country.

After a short unproductive period under the chairmanship of J. D. Bernal the committee concluded that the problem might be better investigated by those in the information sector, and B. C. Vickery, then working at Imperial Chemical Industries, and a delegate at the 1948 Conference, was invited to convene a working party of interested librarians and information specialists. The problem facing them was necessarily a practical one, to provide better tools and methods for the exchange of scientific information, and not to research the subject of scientific classification and indexing per se. Nevertheless, the members of the group were active writers, researchers and developers in the relevant fields, and many were admirers of the ideas of S. R. Ranganathan, the Indian librarian and classification theorist. At that time Ranganathan had published a number of works on the theory of faceted classification, and four editions of his faceted scheme, the Colon Classification (Ranganathan, 1933-1952).

### **3. The fundamentals of faceted classification**

In the period immediately before this, although there was a body of work on the theory of classification, it was largely situated in the disciplines of philosophy and logic, and the pragmatics of organizing physical information stores. Prominent writers of the time, such as H. E. Bliss, looked to the work of philosophers such as John Dewey to provide the conceptual basis of classification, and occupied themselves with ordering of documents according to subject content in the best possible linear sequence, taking into account the 'natural' relationships between subjects, and the needs and expectations of users (Bliss, 1929). Although the coding of subjects using the classification notation was a form of knowledge representation, before the advent of the automated catalogue classification supported the finding of material through its physical organization, and provided an aid to browsing through the collocation of subjects.

What Ranganathan brought to the classification world was a more scientific and mathematical view of information; he emphasised the idea of structure in the subject domain, a structural format that was generalizable across disciplines through the use of fundamental categories to organize concepts, and consequently the potential to deal with subjects in an analytical manner which would lend a measure of regularity and predictability to disciplines so managed. Vital to the analysis was the perception of subject domains as composed of individual discrete concepts that could be combined according to the rules of the faceted system to represent the complex subject content of documents. Whether the operating rules of the faceted classification can be regarded as 'laws' in a scientific sense, and consequently whether the methodology for producing such a system is also a scientific theory of information is an interesting question which is explored in more detail below.

The idea of such a structural and analytical approach to information was not new, and plenty of historical examples can be found to indicate similar thinking.

The artificially constructed universal languages of the seventeenth century academy (Knowlson, 1975) are an elegant and surprisingly accurate precursor of the faceted knowledge organization system, and Vickery himself wrote about the parallels (Vickery, 1953). A number of other modern writers have seen faceted type structures in the works of Hugh of St. Victor (Olson, 2010), and Condorcet (Whitrow, 1983). In the age of documentation Paul Otlet took a highly structured and analytico-synthetic view of information, both in his writings (Otlet, 1990), and in the Universal Decimal Classification, devised in the early 1900s, some decades before Ranganathan (UDC, 1905). An early adopter of categories for the analysis of concepts was Kaiser, whose practical application of 'concrete', 'process', and 'place' categories predates Ranganathan's 'personality', 'energy' and 'space' by twenty years or more (Kaiser, 1911). De Grolier's masterly analysis of classification and coding in his *Study of general categories* also reveals the multiplicity of strands of work in many countries that show a facet like structure (de Grolier, 1962). Although the centrality of Ranganathan's work is acknowledged here, the European tradition of classification and indexing in particular shows a dependence on other sources that were at least contemporaneous with Ranganathan, and might be indicative of a general move towards a more systematic view of information, and the emergence of an early prospect of what could be called information architecture. de Grolier's general categories are very numerous across these different systems, although they share some purposes; the categories can be seen to embrace topical descriptors, roles and relationships. Vickery, in a paper for the 1958 Scientific Conference in Washington also compares different coding and indexing systems with faceted classification, and finds a similar correspondence in style and purpose (Vickery, 1959). The extent to which Ranganathan was the originator of facet analysis, or merely one strand in a general trend towards a more analytical and scientific way of managing information can only be guessed at, but it is clear that he is not alone. Nor was facet analysis peculiar to library and information science. In the 1960s the term facet analysis was used by the Israeli scholar Louis Guttman in the field of social science, but, as far as anyone can see, there was no connexion or interdependence between these two schools of thought (Beghtol, 1995).

#### **4. Classification versus information retrieval?**

What is interesting in the view provided by de Grolier, and in the position of the CRG early on is the identification of 'classification' with 'information retrieval', and there is no sense of a conflict of purpose between them. Certainly the writings of Vickery, ultimately the most retrieval oriented member of the original CRG, do not in the early days draw any distinction between them. The remit of the CRG in its early days seems very clearly to be 'classification for retrieval', and this phrase appears very regularly in the literature of that period, both in the titles and the texts of papers. If there is a difference to be made it is perhaps that classification was a tool, and information retrieval the application or purpose to which that tool was put. Interestingly, Coates 1988 paper on the contribution of Vickery to the field is titled 'The role of classification in

information retrieval', which exactly suggests that relationship (Coates, 1988). The logic and structure of classification systems, particularly those constructed using Ranganathan's principles, was considered as the single most likely way to improve retrieval, and the theory of classification which underpinned those systems was worth pursuing not just for its own sake, but for the effectiveness it lent to retrieval systems.

Nevertheless, the sense of a bifurcation into disparate understandings of classification and information retrieval is apparent in the composition and objectives, both of the Classification Research Group, and comparable research communities elsewhere. This is well evidenced in Miksa's study of the CRG and the Case Western Reserve's Centre for Documentation and Communication Research, where different constituencies are seen to occur, particularly within the CRG (Miksa, 2002). The existence of a library oriented group, with an emphasis on organization and retrieval in physical collections (Coates, Foskett, Mills, Palmer, Wells), and a retrieval oriented group with more interest in machine retrieval and automated information management (Cleverdon, Fairthorne, Farradane, Vickery), is evident not only in their publications, but also in their collaborative work, and can be confirmed by bibliometric evidence. This separation is not nearly so clear in the early stages of the CRG work, particularly in the writings of Foskett and Vickery, who seem not only to conflate classification and retrieval, but also to be as individuals closer in their understanding of the affinity between the two (Foskett, 1959; Vickery, 1959, 1960). In the 1960s, CRG work on a putative new general classification scheme, funded by a grant from NATO, confirms that dual function; Foskett suggests that 'such a scheme will provide at least a matrix for traditional use ... but it will be more. It will be a generalized information retrieval language, with vocabulary and grammar ... and for manual and mechanical retrieval systems' (Foskett, 1970). Foskett further proposes that such a general language can form the basis of not only classifications, but also thesauri and descriptor lists (Foskett, 1971), as indeed has come to be the case today, with facet analysis providing a general theory and methodology for knowledge organization systems, rather than just a means of constructing classifications. Subsequently, more emphasis came to be placed on the classification per se, 'intended for the arrangement of books on shelves, pamphlets in files, and for the arrangement of cards ... in classified card indexes' (CRG, 1964), and it is notable that this is the point at which Vickery drifted away from the group.

## **5. Faceted classification as theory**

The CRG certainly discussed classification principles in some depth. Evidence provided by the CRG Bulletins shows that they considered the categorization of concepts, the nature of relationships, and problems related to notation (a reflection perhaps of Ranganathan's idea, verbal and notational planes). These ideas were tested in the context of several subject specific schemes developed by the members at that time. The possibility of a general scheme

without an initial disciplinary breakdown was also addressed, as was the use of integrative level theory as the basis of ordering entities (Spiteri, 1995). There appears to be less clarity about the number, nature, and relative order of fundamental categories, and of the relationships between concepts in different categories.

What we may say about faceted classification is that, if it is indeed a valid theory of the nature and structure of information, it is a theory that was initially quite slow to emerge. Ranganathan's early theory, and the CRG work of the 1960s and 1970s looks crude by today's standards. Surprising as it seems, the Colon Classification does not mention fundamental categories in the first two? editions, and Ranganathan seems exercised in finding explanations for some of them. Foskett observed in 1958 that Ranganathan had "never given an adequate exposition of the basis of his categories .... [and] adopted them more or less intuitively" (Foskett, 1959). He often opts for ostensive definition, describing the category by reference to its members, or the Method of Residues, defining Personality as what is left over when the other categories have been identified, because in analytical terms it is 'too elusive' and 'ineffable'.

In work on the revision of Bliss's Bibliographic Classification (Mills & Broughton, 1977-) in the late 1960s and 1970s, the theory is applied rather loosely, and with many variations to accommodate what is viewed as a better linear order for physical arrangement. A lack of rigour in the organization of arrays is also evident in some draft schedules, a situation which has only been addressed in more recent revision work. There is, of course, no complete formal statement of the CRG's theoretical findings, and the Introduction to the Second edition of the Bibliographic Classification provides the only general indication of that theory (Mills & Broughton, 1977a). The introduction is rather pragmatically oriented, however, and there is no real examination of the principles on which the method of constructing BC2 is based. This doubtless reflects the original mission of the CRG, which largely concentrated on what was needed to build a logical and effective classification; its theoretical base covers the nature of categories, the allocation of terms or concepts to categories and facets, the identification and correct naming of arrays (or sub-facets), relationships between concepts in facets, the determination of filing and citation order, the allocation of notation and the way in which it should function, and the creation of a grammar, or syntax, for the faceted language through the rules for combination. The nature and relationships of concepts within the individual facet are still mainly dependent on traditional knowledge organization principles based in classical logic, and it is essentially in the inter-facet relationships that new ground is covered.

Spiteri (1998) compares the two traditions of Ranganathan and the CRG and attempts to produce a unified model. It is evident, however, that there are distinct differences, and when recent interpretations of facets are included we can see several models of the faceted domain.

What defines a theory is that it allows you to generalise from the specific to the particular, so that findings are not limited to individual cases or contexts, and in this respect one can say that facet analysis has theoretical respectability. Currently, it is possible to speak of a theory building methodology, particularly in the social sciences, and it may well be that facet analysis falls into this category. In the revision of Bliss's Bibliographic Classification, for example, facet analysis has been employed in a wide range of disciplinary areas, and found, with some modifications, to be equally applicable to all. On a social science model, the different subject domains might be regarded as case studies from which the theory emerges. What is not a given is that the number of categories for analysis are fixed, or that they are not susceptible to interpretation. Citation order too is variable, although the principle of a standard citation order, as conceived by Vickery in the 1960s (Vickery 1960), remains the default position for this universal classification scheme.

When categorization in faceted classification is compared with other methodologies for the analysis either of domains, or text corpora, some interesting similarities (and distinctions) emerge. Analytical methods such as systems theory (Checkland, 1981) and grounded theory (Saladana, 2013) both make use of categorization and coding for domain modelling and for theory building. The categories used in soft systems methodology (customers, actors, transformations, weltanschauung, owner and environmental constraints) map neatly to the CRG's patients, agents, operations, disciplines, entity/organizations, and properties), and grounded theory's coding process has the same objective of identifying and building categories from elements in a text corpus, although the nature of the categories is more flexible than in either soft systems or facet analytical methods. However, grounded theory, like facet analysis, conceptualizes the terms in the text in order to collocate common content. Star (1998) has compared grounded theory and faceted classification, but concentrates in her analysis on the historical and political factors which gave rise to them, rather than discussing their similarities.

## **6. Faceted classification in the twenty-first century**

Today, the influence of faceted classification on a whole range of methods of information retrieval is undisputed (Broughton, 2006). Hjørland has referred to facet analysis as "probably the most distinct approach to knowledge organization within Library and Information Science ... in many ways it has dominated what has been termed 'modern classification theory'" (Hjørland, 2013), and its impact can be seen, not only in the managed information environment, but also in the unmanaged context of the world wide web (Adkisson, 2005; La Barre, 2006).

The introduction of faceted methods of schedule construction is very apparent in the major classification schemes. The Dewey Decimal Classification shows many examples of small scale editorial revision to improve the structure of the scheme at the level of its organization into facets and sub-facets, or arrays, and

there have recently been major revisions to introduce a more faceted structure in the interests of a more equitable treatment of minorities. A substantial example is the revision of Class 2, Religion, published in 2012, which adapts the facet structure introduced into UDC in 2000 (Broughton, 2000), which itself borrows from the 1977 revision of Bliss's Bibliographic Classification Class P Mills & Broughton, 1977b). 'Facetization' has been a major part of editorial policy for UDC for some decades now, with a consequent simplification and streamlining of the schedules, removing compound classes and tightening up the internal structure (McIlwaine & Williamson, 1994).

Subject cataloguing and indexing also demonstrates the faceted effect, with Library of Congress's FAST (*Faceted application of subject terminology*) headings (<http://www.oclc.org/research/themes/data-science/fast.html>), intended to provide a simpler, more consistently structured set of headings, more appropriate for digital resources, and for post-coordinate use. These have been under development since 1998, and are now in operation in some major libraries worldwide. The thesaurus world is perhaps even more heavily inclined towards faceted principles, with many controlled vocabularies built using those methods; established vocabularies of this kind include Art and architecture thesaurus (<http://www.getty.edu/research/tools/vocabularies/aat/>), Eurovoc (<http://eurovoc.europa.eu/>), and the CAB thesaurus (<http://www.cabi.org/cabthesaurus/>). The recently revised British Standard for controlled vocabularies (British Standards Institute, 2005), and the new International Standard (<http://www.niso.org/schemas/iso25964/>), which draws heavily upon it, specifically mention facet analysis as a useful method for building terminologies in a systematic manner.

A more recent innovation in the managed information environment is the discovery tool, with its use of what is termed faceted browsing in the catalogue interface. The faceted browsing view is not dissimilar to early faceted search techniques in online bibliographic databases, where multiple facets were accessible through drop-down menus for the purpose of search formulation and modification. In the faceted browsing tool the facets are simultaneously visible on the search screen, and are brought into action as filtering tools. This is not quite classical facet architecture of the Ranganathan or CRG school, and is more redolent of the faceted search techniques used in e-commerce, but it serves to demonstrate how facet analysis has become functionally synonymous with structured information organization in a more general sense. The effectiveness of such tools is demonstrated by their increased popularity. In UK academic libraries they are ubiquitous, and they are also being taken up in the public library sector (Broughton, 2017). Interestingly, there is convergence towards a dominant package (Primo) in the same way that classification and subject cataloguing have become dominated by the large US systems of Dewey, Library of Congress Classification, and Library of Congress Subject Headings.

On the world wide web, e-commerce sites routinely adopt a facet like structure to support search through the combination of search terms in different facets,

and the filtering of results by the application of additional attributes displayed in facets. Like the faceted browse of discovery tools these are flat structures as compared with a conventional faceted classification, with most of the vocabulary in the 'personality' or 'entity' category, differentiated by various 'properties' of the entity. However, the methodologies for building such search and display tools, and the underlying conceptual thinking, is well documented in a strand of facet analysis parallel to the traditional, more academic, work of library and information scientists. It is largely within this context that a formal understanding of information architecture emerges, with the formation of the Information Architecture Institute in 2002, and the appearance of information architecture as an element in school curricula. The latter show some considerable overlap with the corpus of faceted classification literature, and the two are clearly closely related.

## **7. Conclusion**

What is it about faceted classification that has made it so hospitable to information retrieval, particularly automated information retrieval? And is it just a powerful methodology, or is there something more substantial about the underlying conceptual nature of facets? It is clear that the kind of structure created by the application of facet analysis is highly compatible with machine management, and that the traditional logic employed in the construction of faceted schemes and the representation of relationships between concepts is easily 'understood' in programming terms. The inference engines used in ontologies can readily exploit the basics of a faceted knowledge organization system, although the complexity of a fully faceted classification using the whole range of categories and inter-category relationships is much less easily expressed in machine readable terms. An examination of website interfaces suggests that, in a similar manner, relatively basic understandings of facet structure are employed, with few facets, and the different arrays used as filters rather than complex query building tools.

What does seem to be the case is that there are two components to faceted classification theory: the organization of concepts into categories or facets, and the relationships between those categories; and the internal organization of categories which utilizes traditional logic to construct hierarchies and their relationships. The latter is certainly based on a rationalist approach to analysis, but the former has some aspects of a theory building methodology in common with other contemporaneous content analysis tools. In terms of the applicability of facet analysis to machine retrieval it is principally the logical, hierarchical elements of the analysis that we see in web architecture and in semantic technologies.

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Vanda Broughton is Emeritus Professor of Library & Information Studies at University College London, and the author of a number of books and articles on faceted classification and controlled vocabularies. She has worked on faceted classification systems since 1972 when appointed as Research Fellow on the Bliss Classification revision (BC2) project to work with Jack Mills. From that time she was a member of the UK Classification Research Group (CRG), then under the Chairmanship of Mills alongside such leading figures as Douglas Foskett, Eric Coates, Jason Farradane, Robert Fairthorne and Derek Austin. She had Joint Editorship of BC2 with Jack Mills until his death in 2010 when she became sole Editor and Chair of the Bliss Classification Association. She has also been an Associate Editor of the Universal Decimal Classification, sometime member of the IFLA Committee on Classification & Indexing and a founder member of the UK Chapter of the International Society for Knowledge Organization, which she chaired from 2007-2011. Her work in the UDC editorial team resulted in the application of CRG-type of facet analytical theory to the revision of class 2 Religion and several systematic auxiliaries and she has also researched the use of faceted vocabularies in digital environments. The FATKS project at UCL looked at methods of machine handling of faceted classification data, and associated problems of subject metadata in the humanities. In addition to the ongoing revision and development of the Bliss Classification, her current research work, focuses on the development of a broader theory of facet analysis and the use of encoding to support automatic generation of both thesaural and systematic knowledge structures from core terminologies. In the 2013 Research Excellence Framework for UK higher education, her work on faceted classification was chosen by the Department of Information Studies to represent the impact of its research on life and society beyond academia.