Facet†

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Abstract: S.R. Ranganathan is credited with the introduction of the term "facet" in the field of knowledge organization towards the middle of the twentieth century. Facets have traditionally been used to organize document collections and to express complex subjects. In the digital world, they act as filters to facilitate navigation and improve retrieval. But the popularity of the term does not mean that a definitive characterization of the concept has been established. Indeed, several conceptualizations of the facet co-exist. This article provides an overview of formal and informal definitions found in the literature of knowledge organization, followed by a discussion of four common conceptualizations of the facet: process vs product, nature vs function, object vs subject and organization vs navigation.

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1.0 Introduction

As a foundational element of bibliographic classification systems, facets have been used to structure document collections, disciplines and the whole of knowledge. In today's digital world, facets act as filters to facilitate navigation and retrieval and to improve the presentation of search results. But if the concept of "facet" is now more popular than in Shiyali Ramamrita Ranganathan's own time, it does not mean that a definitive characterization of this abstract notion has been achieved or that all those who discuss and use facets are entirely clear as to the nature and function(s) of this handy device. The technology that has made possible the sharing of responsibilities for information distribution also opened a path to a wider interpretation of the nature and role of facets in information systems (Hudon and Mustafa El-Hadi 2017; LaBarre 2010a; Spiteri 1998; Spiteri 2010), with LaBarre alluding to a "Tower of Babel" (2004, 80).

In his *Colon Classification* (*CC*), Ranganathan first allocated concepts and terms to one of five fundamental categories or facets (personality, material, energy, space and time) on the basis of the nature of the entity represented; he then proposed indexing formulas for each discipline, *de facto* assigning to each facet a specific role in the sentence thus created. It appears that Ranganathan was not able to, or more likely chose not to, dissociate the semantic (nature) and syntactic (function) dimensions of facets as they are exploited in knowledge organization (KO) and information representation (Maniez 1999). This original ambiguity was maintained by the Classification Research Group (CRG) (1957) and in the many subsequent sets of facets inspired by

its proposals. The fusion/confusion of semantic and syntax may have led to the diversity of definitions and applications of facets observed in contemporary information systems.

The following is an overview of formal and informal definitions of the concept of facet found in KO and in library and information science (LIS) literature more generally, without determination of which one(s) should be considered most complete, relevant and/or useful. Although numerous references will necessarily be made to facet analysis, this article does not discuss specific applications of facets or extend to descriptions of existing faceted classifications, thesauri or search interfaces, nor does it pretend to exhaustivity in referencing appropriate literature.

2.0 Historical notes

In KO, S.R. Ranganathan is credited with the introduction of the term facet towards the middle of the twentieth century. First trained as a mathematician, the Indian master has influenced all areas of librarianship in the course of his long career. Lancaster and colleagues argue (1992, 276) that "one cannot fail to be impressed by the very wide range of topics with which [Ranganathan's] name has been connected," thinking it "unlikely that anyone in the field of LIS has been cited in more diverse contexts." Ranganathan's interests ranged from library administration to library history, LIS education to LIS terminology, quantitative methods to users behaviour and expectations. But it is in cataloging and classification that he was most influential and "there seems little doubt that the majority of people in [our] field associate [him] most closely with classification theory" (Lancaster et al. 1992, 272), a fact demonstrated by a bibliometric study reported by Finks and Haug (1992). Svenonius considers (1992, 176) that "he, more than any other scholar of our discipline, has striven to establish classification upon a scientific foundation." De Grolier (1973) recognizes in Ranganathan a talent for theory construction, as well as a pragmatism put to the test by his daily activities in the library. A prolific writer, Ranganathan had published his *Five laws of library science* as early as 1931. Textbooks on library administration, reference services and school and college libraries followed in 1935, 1941 and 1942 respectively.

At the same time, Ranganathan was working on a theory of classification, which would eventually lead to the *Colon Classification* (*CC*), first published in 1933. Vickery (1966) notes that the technique of facet analysis was first developed intuitively before progressing to a more intellectual plane. If facets were already present as a concept in the original *CC*, it is in the 1950s only that the term was defined and popularized in a movement led by the CRG in its application of the master's principles to construct domain-specific classification schemes. The fourth edition of the *CC* is indeed the first version "whose design is explicitly based on the Postulations approach to faceted classification" (Kashyap 2003, 14), an approach thoroughly explained for the first time in 1957. From then on, the importance of facets and facet analysis is made evident by their impact on general and special classification schemes and their use in the development of other indexing languages, such as thesauri (Broughton 2006; Vickery 1966).

Ranganathan did not invent the concept of facet; the idea was definitely "in the air" at the time. McIlwaine (1992) goes so far as stating that he merely specified the foundations of facet analysis and refined the terminology. Paul Otlet and Henry Bliss were using a similar device in their own work around classification (Broughton 2013; Canonne 1993; McIlwaine 1992). At the end of the nineteenth century, Otto Kaiser had created a systematic indexing language based on three categories (concrete, process, country) and a set of rules for combining them; Svenonius (1978) claims that he is the true originator of faceted indexing, the first to recognize the usefulness of facets in the construction of expressions in a synthetic index language. Common subdivisions, such as chronological, geographical and form subdivisions, already provided in the Universal Decimal Classification (UDC) and in the *Dewey Decimal Classification* (*DDC*), are also regarded as facets of a subject (Broughton 2013; Broughton and Slavic 2007; Canonne 1993; McIlwaine 1992; Slavic 2011; Stiles 1992). De Grolier believes (1965, 102) that "the term facet itself is just a new, fashionable, word for designating the series of subdivisions of a given subject according to one, and one only, of its characteristics," reminding us "that there were faceted classifications, in that sense, a long time before the word facet came into use: the classification created by Dobrowolski for the International Institute of Welding, in the early 40s, was of that type." Furthermore, the term facet had been used as early as 1933 by Gérard Cordonnier who wrote (quoted in Beghtol 1995, 199): "I insisted on the absence of linear order between intellectual objects, saying that their relations were comparable to the facets of a diamond ... Later, I myself used the expression 'point of view' in the same sense." The term facet was first used by Ranganathan in 1944, presumably in *Library classification: fundamentals and procedure;* before then, the terms "standard unit," "sequence" or "train of characteristics" were used to denote the concept (Beghtol 1995).

The concept of facet is not exclusive to LIS. Beghtol (1995) compares Ranganathan's postulates with the parallel development of facet theory by Louis Guttman, a most influential and original contributor to the field of quantitative social and behavioral research (Borg and Shye 1995). Both fields used the term with the same meaning(s), making it interdisciplinary despite a lack of any connexions (at the time) between the two developing fields. If Beghtol sees this as evidence that facet principles may be "cognitively availa-

ble to all human beings" (2006, 47), regardless of language, culture or academic discipline, she also suggests (Beghtol 1995) that the ambiguity surrounding the term facet, with its numerous synonyms, makes it difficult to relate literatures and to perceive links between different fields of knowledge. Star (1998) also brings together two theories/methodologies, grounded theory and faceted classification, that have in common the use of facets. She notes (1998, 222) that both methodologies began as "reform movements against traditional structures, without abandoning the attempt to formalize and standardize." Binwal (1992) relates facets and faceting to other known attempts at knowledge representation, such as predicate and argument categories, Fillmore's case grammar, Schank's and Wilks' semantic primitives in linguistic analysis and predicate logic, frames and semantic nets in artificial intelligence.

Ingwersen and Wormell (1992) believe that Ranganathan had recognized, towards the end of his career, the huge potential of information technology for information retrieval and the potential of his own theory in such context. Perceiving the capabilities of computers to create multiple access points and allow for dynamic search procedures, he sensed that electronic engineering would present "a challenge to the theory of classification" (Ingwersen and Wormell 1992, 185). Ellis and Vasconcelos (1999), convinced that the use of facets would alleviate problems related to subject searching on the expanding web, suggest that the genius of Ranganathan lies in the applicability of his proposals to other technological environments. Nowhere is this more obvious than in the recent repurposing of facets and facet analysis.

Broughton and Slavic (2007) recall that the potential for faceted approaches to information retrieval in electronic environments had been perceived as early as the beginning of the 1980s. The authors note the significant contribution of Pollitt and his team (1998) who developed "applications such as 'view-based' and 'facet space' systems which, within a Windows environment, allowed the simultaneous display of two or more facet hierarchies using cascaded-menus and interactive windows as an aid to search formulation and retrieval" (Broughton and Slavic 2007, 728).

At the turn of the twenty-first century, the facet (by then a buzzword) and its applications were fast becoming a hot topic not only in KO conferences, but also within the knowledge management (KM) and information architecture (IA) communities (Crystal 2007; LaBarre 2004; LaBarre 2010b). Information architects and knowledge managers were discovering "a legacy form of information organization and access, the faceted analytico-synthetic theory" (LaBarre 2006, 359). Commercial developers began to exploit the basic faceted navigational structures still commonly found in retail web sites (Broughton and Slavic 2007). Crystal sees facets as fundamental to IA and suggests (2007, 18) that "rather than thinking of facets as a way to improve IA, we should think of facets as the foundation of IA."

Broughton's 2006 overview (68) of the use of facet still applies today:

> It is clear that faceted classification in some form or another now plays an integral part in most methods of information retrieval. It is very well established as a method of construction in classification schemes and thesauri, and has affected the development of even the most conservative of systems in the area of traditional document description and organisation. It is popular as a navigational tool for web sites of all sorts, helping to structure all manner of objects and information about them ... It is beginning to be taken up by researchers in the fields of automatic indexing and the semantic web as a conceptual tool to assist in the understanding of the most complex relationships between objects.

Hjørland (2013) and Frické (2017) both deplore, however, the lack of productive exchanges between the online searching and AI communities and the KO community in relation to facets and facet analysis.

3.0 What is a facet?

The theory, principles and postulates around facets and facet analysis are seen as Ranganathan's major contribution to LIS (Beghtol 2006; Beghtol 2008). They have been referred to as one of the most significant theoretical developments of the twentieth century in our field, a true [new] paradigm "for it is an influential scientific achievement with a strong theoretical, cognitive and methodological background, rather than a simple empirical accumulation and description" (Xiao 1994, 64).

But what exactly is a facet? The concept is an abstraction, its intension more difficult to circumscribe than that of any term designating an object that can be physically observed and manipulated. Maniez (1999) remarked that, after decades of usage, the meaning of the term remained to be standardized, the term being used both in highly specialized domains and in popular usage, and routinely applied in the context of any grouping process in diverse settings. Variations in meaning also stem from the existence of three somewhat divergent traditions that have emerged around facet theory: the Indian tradition, closest to the canons of Ranganathan, the British tradition and the more recent and flexible North American tradition (LaBarre 2010a).

Most early discussions of the notion of facet related to the construction of a classification structure. The topics of facet analysis and faceted navigation are more common

nowadays, but the difficulty of finding clear definitions of this entity that we call a facet persists. The ambiguity surrounding the term extends naturally to the definition of facet analysis, which also suffers from multiple "disparate interpretations" (Broughton 2001, 71), some of which are (Broughton 2002, 137) "very different from the original work of S.R. Ranganathan." These interpretations range from no more than the name of a field in a database to fundamental categories used to structure complex models of the information universe (Broughton 2006). In the next section, definitions culled from traditional lexical sources are presented first, followed by descriptions extracted from KO literature published since 1955.

3.1 Lexical and terminological sources

The online version of the *Oxford English Dictionary* (www.oed.com) proposes three distinct entries under the term facet. The second entry defines an original meaning of the term as: "one of the small cut and polished faces of a diamond or other gem. In later also: a flat, usually smooth, face or surface of any object." Figuratively, the term designates "a particular side or aspect of something." A meaning specific to LIS is "each of several different categories or classes into which something can be simultaneously classified." The term is borrowed from the French *facette*, itself from the Latin *facies* (form, appearance, face). In the *OED Historical Thesaurus* (www.oed.com/thesaurus), facet is related to side, respect, prong, parameter and dimension. In his *Vocabulaire élémentaire des classifications*, Canonne defines the facet as (1993, 70, our translation) a "set [of objects, concepts, etc.] established on the basis of a single characteristic of division." In a textbook destined to LIS students, Taylor describes the faceted classification as (2006, 394) one that "differs from a traditional one in that it does not assign fixed slots to subjects in sequence, but uses clearly defined, mutually exclusive and collectively exhaustive aspects, properties or characteristics of a class or specific subject. Such aspects, properties, or characteristics are called facets of a class or subject."

The tenth and most recent edition of the *ALA Glossary of Library and Information Science* defines the facet functionally as (2013, 104) "a distinct metadata element that can be used to describe one characteristic ... in some databases and catalogs, facets can be used in narrowing a search" (one should note that the expression "metadata element" is not itself present in the *Glossary*, and that the term "metadata" is defined as "Information used to describe a work to enable discovery and use" (2013, 166)). It is only when scanning the definition of "facet analysis" that one can get a sense of the nature and function of the facet: "in classification, the analysis of a subject to determine its fundamental characteristics" (2013, 104).

In terms of clarity and usefulness, a better definition is found in Reitz (2004, 267): "the entire set of subclasses generated when a class representing a subject in a classification system is divided according to a single characteristic, for example, the subclasses 'children,' 'adolescents,' and 'adults' generated by the division of the class 'people' according to the characteristic age.' In a more general sense, a facet is any one of several distinct aspects of a subject."

The current official definition provided by AFNOR reads (Boulogne 2004, 103, our translation): "categories of concepts of a same nature or represented from a same perspective such as phenomenon, process, property, tool, allowing for discipline-independent groupings of concepts."[1] ISO25964-1:2011, an extension of British Standard 8723, states (International Organization for Standardization 2011) that a facet is a "grouping of concepts of the same inherent category."

3.2 Knowledge organization literature

Most definitions of the concept of facet are embedded in texts describing facet analysis and faceted classification. As the following quotes will show, the ambiguity of the term often leads authors to systematically use it in combination with one or more others (e.g., category, class, grouping, dimension, value, attribute), as if eager to cover all bases. This has led to numerous interpretations and applications of the concept.

Before the year 2000, the literature on facets and facet analysis was dominated by the works of Ranganathan himself, and of Brian C. Vickery, a prominent member of the CRG. From the year 2000 on, as the concept and the approach gained in visibility, a wide variety of writers added to the corpus, with numerous and significant contributions by Vanda Broughton (2001; 2002; 2006; 2013) and Kathryn LaBarre (2004; 2006; 2007; 2008; 2009; 2010a; 2010b; 2011).

Ranganathan posited accurately that any complex entity could be viewed from a number of perspectives or facets, but he was not forthcoming in providing a clear definition of the concept that is at the heart of his theory. He writes (Ranganathan 1957a, 4): "Analytico-synthetic classification is so-called because it starts with the analysis in the idea plane of the main idea embodied in a document into facets corresponding to certain fundamental categories ... Whatever categories are adopted, the classification then translates the name of the isolate term in each facet into its isolate number according to the schedule of the scheme in use, and finally synthesizes in the notational plane the isolate numbers into a class number." In an appended glossary, the facet is defined as "the totality of the subclasses of a basic class corresponding to a single fundamental category and based in a coherent set of characteristics not leading to an organ or a constituent of the typical entity of the universe classified,"

a category being "a form or class of concepts, varying from subject to subject, into which isolates can be grouped" (Campbell 1957, 13). Those who are familiar with classification theory recognize the words, but the complexity of their arrangement has left many somewhat perplexed. LaBarre considers (2010b, 245) that Ranganathan's most complete description of facet theory consists of "a series of seven normative principles, forty-two canons, thirteen postulates, twenty-two principles, and nine devices... written in often inscrutable language." The editors of a later version of *CC* define facet more simply as "a generic term designating any constituent of a compound subject" (LaBarre 2010b, 270), a rather different meaning than that inferred previously. Indeed, Ranganathan own's perspective on the facet had evolved over time. In 1957, he viewed the facet as (1957b, 170) "the totality of the isolates formed on the basis of a single train of characteristics;" ten years later, he presented it as (1967, 88) "a generic term used to denote any component—be it a basic subject or an isolate—of a compound subject."

Kashyap (2003) concurs with Vickery (1966) and Maniez (1999) that Ranganathan's theory did not clearly distinguish semantics and syntax. He writes (Kashyap 2003, 13): "Ranganathan divided the universe of knowledge into traditional Basic Subjects or Main classes *of subject* [2] followed by a sub-division of these basic subjects or classes through the application of '*trains of Characteristics*' or '*facets*.' The term '*facet*' refers to a manifestation of any one of the five fundamental categories." Ranganathan then "postulated that the make-up of a Compound Subject constitutes one or more of five mutually exclusive *fundamental categories*: Personality (P), Matter (M) or Property, Energy (E) or Action, Space (S) and Time (T)" (Kashyap 2003, 13).

De Grolier stresses (Grolier 1962, 44) that Ranganathan remained "faithful to his method of using words in a particular sense and creat[ed] a kind of 'Ranganathanian' language, which certainly does not facilitate the comprehension and use of the classification system by other than initiates." Campbell (1957), Spiteri (1998) and Kashyap (2003) also emphasize the terminological peculiarities of Ranganathan's discourse. In a critical analysis of instructions surrounding the application of the *CC*, de Grolier denounces an abundance of vague and inexact definitions; he declares (Grolier 1962, 57) that facet theory is "singularly empirical and often very arbitrary."

Members of the CRG are hardly clearer when they propose (1957, 138): "The terms subsumed under a given genus—e.g. a main class—are not all derived from that genus by differentiation using a single characteristic of division. They can be sorted into groups or facets, each of which is derived from the genus by a different characteristic." And further, using an example (1957, 144-145): "[facets] are the characteristics of division by which the terms are derived from the class chemistry (i.e. kind of, state of, property of, reaction of, operation performed on ...), looked at in another way, these characteristics are the logical categories by which the various terms are assembled." As early as 1955, de Grolier had observed slight divergences in term use even among CRG members. Douglas J. Foskett considered category an apt synonym for facet and facet analysis as the analysis of a subject in its entirety into a certain number of categories of things. By 1960, Vickery and others were also using the term to represent "conceptual categories of high generalities and application that can be used to group other concepts" (LaBarre 2010a, 108-109).

Vickery, for whom the facet is primarily an "analytical tool" (1966, 13), defines the concept as (1966, 45) a "homogeneous group of terms, derived by taking each term and defining it with respect to the entities that are at the center of interest in the classification." Much later he writes (Vickery 2008, 148): "During search we need to be able to separate out any particular aspect of interest to us. But this requires that each aspect is separately represented in the classification. It is these separately listed aspects that are known as facets." Vickery specifies (2008, 151) that "people experienced in the construction of faceted schemes stress the value of taking into consideration lists of general or 'fundamental' facet categories that may be applicable in many subject fields." He presents fundamental categories as (Vickery 1960, 107) a "provisional guide," whose role is to suggest "possible characteristics which should not be overlooked."

De Grolier, who himself uses the terms category and facet interchangeably, describes briefly (Grolier 1974) other perspectives on the concept: that of Robert Fairthorne, who defines facets as the principal categories applicable to a specific activity and whose combinations allow us to synthesize specialized subjects; that of Jack Mills for whom facets or categories apply to a series of classes derived from the same basis of division; that of Jean-Claude Gardin, who assimilates facets to functional classes within a syntactic structure.

An early voice from the online community, that of Stephen P. Harter, proposes the following definition (1986, 244): "a concept-group, consisting of terms that will be considered to be equivalent by a searcher for purposes of a given information need."

In her presentation of Ranganathan's fundamental categories as "building blocks into which any phenomenon can be broken down," Kwasnik confirms that they are "commonly referred to as facets" (1992, 103), imitating in this the master himself. Ingwersen and Wormell describe facet analysis as (1992, 187) the process of "splitting specific subjects into various resultant constituents—facets—and then [synthesizing] them into subjects sought with the help of notation." Foskett describes the process as (1992, 232) separating out "the various elements of a compound subject, by means of relating them to certain general categories." Garfield explicates the basic principles of *CC* as (1992, 125) re-

quiring "the analysis of a subject to determine its various aspects, called facets." Langridge notes that the term facet is used in the context of developing a classification structure as well as in the context of representing the content of a document; this leads to a bi-dimensional definition (1992, 74): "any component of a compound subject or the set of classes produced by one characteristic of division."

In her comparison of Ranganathan and Guttman's theories, Beghtol proposes distinct definitions. In LIS, the facet is (Beghtol 1995, 197) "the totality of the isolates enumerated together ... as possible manifestations of a particular fundamental category," explaining further that "every subject has one or more aspects which correspond to the characteristics used as a basis for division. The sum total of the divisions of each aspect we shall call a facet." In social science research, a facet is (Beghtol 1995, 197) more simply "a set of elements" or "any set of mutually exclusive categories." Borg and Shye, focussing on Guttman's theory, refer to the facet as (1995, 25) "a set of elements (i.e., types, classes, categories, attributes, etc.) that classify objects of interest ... The facet gender, for example, partitions a population into two subsets, males and females."

The facet is a classification device as long as it represents a category rather than an individual characteristic (Maniez 1999). Maniez reminds us that, fundamentally, at the level of general language, one could say that the *DDC*'s main classes are facets of knowledge, that pedagogy is a facet of teaching, that the fields of a bibliographic description are facets of a document, that each descriptor in an indexing formula is a facet of a subject. His own definition reads (1999, 255, our translation): facets are the "top levels of a hierarchical structure of concepts obtained by progressive reduction from the specific to the generic."[3]

Broughton describes Ranganathan's innovative bottom up method of developing a classification structure, leading to the organization of individual terms in subject areas into five broad categories or facets (2001). In that sense, facets can be understood as (Broughton and Slavic 2007, 734) "classification building templates."

Facet analysis separates out the various elements of a compound subject by means of relating them to certain general categories, which are comprehensible to any user (Foskett 1992). Facets are groups of concepts/terms of the same nature. Foskett explains (Foskett 2009, 1819) that "a facet can be said to be all the classes produced when a subject is divided by one and only one characteristic ... A facet may consist of entity terms, such as elements in chemistry, or crops in agriculture; forms of entities, such as solid, liquid, gas; operations made on entities, such as combustion, forging, harvesting; tools for operations, such as presses, X-rays for therapy, microscopes; states of being, such as health and disease." Mills prescribes (Mills 2004, 550) a division of the subject "into broad facets (categories)" and a division of "each facet into specific subfacets (usually called arrays)" before deciding the "citation order of facets."

LaBarre favours Taylor's (2006) definition, considering that it presents a traditional understanding of facets as (LaBarre 2007, 82) "the categories, properties, attributes, characteristics, relations, functions or concepts that are central to the set of documents or entities being organized and which are of particular interest to the user group for whom a particular resource is being created."

The association of category and facet is very common, but several specialists do make a distinction between the two. Langridge specifies (1973, 62) that "we use the term 'categories' when referring to the general structure of a classification scheme, 'facets' when referring to the manifestation of these categories in different classes." Cheti and Paradisi (2008) establish this semantic distinction in their description of the *Nuevo Soggetario* restructuring process: in the thesaurus, there are only four fundamental categories and thirteen facets. The authors usefully specify (2008, 227) that "the category is the analytical tool which guides the analysis and the terminology structure development at the most abstract level (categorial analysis) [identifying] the four main groupings into which the general classes (facets) are organized: Agents, Actions, Things, Time." The facet is (2008, 227) "the analytical tool used, in general, to divide a class into subclasses by one or more characteristics of division of the class (facet analysis)." Gnoli (2008a), who sees facets as a natural way of analyzing and organizing any kind of concepts, also distinguishes facets and categories. Along with Vickery, he believes (Gnoli 2008b, 180) that "a guide to the identification and ordering of facets can be provided by a set of general categories, valid throughout all classes, to which the facets belong."

Satija and Singh (2013) define several basic terms in relation to one another, starting with the isolate, the smallest unit of knowledge in the *CC*. A facet is then (2013, 267) "a group of isolates obtained by the application of a single characteristic." A main class is split into [P], [M] and [E] categories, these (2013, 271) "categories are further divided into facets, and facets into the ultimate isolates."

The post-2000 literature includes significant contributions by knowledge managers and information architects who share simpler conceptualizations of the facet. In North America, facets more closely resemble ad hoc categories and often bear only faint resemblance to facets created through a process of facet analysis and to the principles outlined by Ranganathan (Kwasnik 1992; LaBarre 2010a). The oft-encited example provided by Denton (2003) is a case in point:

> Each wine has a certain colour. It comes from a certain place. It is made from a particular kind (or blend) of grape. Its year of vintage is known. It has been guaranteed to be of a certain quality by its country's wine

> authorities. It comes in a container of a given volume. It has a price ... With facets, we can set up a handful of categories that will combine to fully describe the wines: colour, origin, grape, year, appellation, volume, price. Each category is populated with the right terms and organized in an appropriate way ... This is a faceted classification: a set of mutually exclusive and jointly exhaustive categories, each made by isolating one perspective on the items (a facet), that combine to completely describe all the objects in question, and which users can use, by searching and browsing, to find what they need.

In a faceted web browser, the facet is a tool used "to partition the information space using orthogonal conceptual dimensions of the data" (Labarre 2010a, 114). A survey conducted by LaBarre (2006, 364) among KM and IA specialists reveals "a sophisticated understanding about fundamental concepts such as facet," a concept they define broadly as a "dimension, attribute, characteristic, category or property." She notes elsewhere (LaBarre 2007) that KO specialists, in their discussions about new catalogue interfaces, use the term facet in a strikingly similar fashion.

4.0 Itself a multifaceted concept

A survey of relevant KO literature spanning the past sixty years uncovers more than one way of looking at facets. Four conceptualizations of the facet have been identified: process vs product, nature vs function, object vs subject and organization vs navigation. Each conceptualization is presented here in the form of a dichotomy whose poles could appear at first glance to exclude one another, but this is rarely the case. The possible combinations of these conceptualizations of the facet (e.g., facet as function used to describe a subject with a view to facilitating navigation, or facet used to organize a collection of objects according to some physical characteristics) add complexity to the definition and theorizing of the concept.

4.1 Process vs product

A few KO specialists see the facet as a criterion, a characteristic, a basis for allocating objects or concepts to classes, rendering facets essential to the dividing and structuring process. Ranganathan had to use this interpretation when he determined that an entity belonged to the "personality" category/facet rather than to the "matter" category/facet. According to LaBarre (2010b), this conceptualization of the facet springs from the mathematical concept of parameter (factor, aspect or element), permitting the identification of sets of distinct cases. Within an indexing language, facets as characteristics have been presented as node labels in the form of the preposition "by" followed by a noun or expression representing an actual criterion (gender, educational level, size, breed, habitat, etc.). Jean Aitchison appears to favour this meaning when she uses the term to describe a process of division to create mutually exclusive groups (Maniez 1999). Describing a project in the field of education, Hudon (2008) selects five facets judged essential to the classification of resources in virtual libraries: agent (who?), activity or process (what?), method or tool (how?), space or context (where?) and time (when?).

But when the facet is described as any grouping composed of entities sharing one or more characteristics, it is seen as the resulting class of objects, concepts or terms, as the product of the dividing process. In his *CC*, Ranganathan used the term facet to name the set of isolates offered as potential manifestations of a fundamental category, in keeping with an earlier description of the facet as (Beghtol 2006, 43, quoting Ranganathan 1950) "the totality of subclasses based on a single train of characteristics of a main class." Vickery writes (1960, 12) that "[t]he essence of facet analysis is the sorting of terms in a given field of knowledge into homogeneous, mutually exclusive facets, each derived from the parent universe by a single characteristic of division;" he later emphasizes this conception of the facet when he talks (Vickery 2008, 152) of "populating the facets" and of "assigning terms to a facet." Broughton specifies (2001, 80) that "with terms assigned to categories, these categories are now named facets within the discipline."

This dual perspective on the facet may stem directly from Ranganathan's own canons and principles. With the objective of explaining in simple terms the most important of these, Spiteri (1998) exploits the ambiguity surrounding the term facet to demonstrate that it can be considered simultaneously as a device for dividing and the result of the division. The canon of differentiation (Spiteri 1998, 5) "advises that when dividing an entity into its component parts, it is important to use characteristics of division (i.e. facets) that will distinguish clearly among these component parts." The canon of relevance (Spiteri 1998, 6) "states that when choosing facets by which to divide entities, it is important to make sure that the facets reflect the purpose, subject, and scope of the classification system (ex. Grade in Education)." In a faceted system (Spiteri 1998, 8), "classes are formed by the application of characteristics of division (i.e. facets)." The principles for helpful sequence (Spiteri 1998, 14) "are concerned with order in array, i.e. the order in which foci (or individual terms) are arranged within their respective facets;" in this latter case, it seems clear that facets are not anymore a trait or characteristic. Facets must be (Spiteri 1998, 18) "homogeneous and mutually exclusive, i.e., that the contents of any two facets cannot overlap." The recommendation (Spiteri 1998, 23) that "facets should be arranged in a relevant sequence," however, could apply to both facet as

a criterion for division and facet as a set of elements resulting from the division.

4.2 Nature vs function

When reference is made to their nature or essence, the categorization process consists in allocating objects and concepts to a facet, giving them a meaning that will not vary with the context of use; this is what Ranganathan did in the first stage of developing the *CC*, and most early faceted classifications adopted the same approach. Fundamental and mutually exclusive facets only (e.g., living being, physical object, attribute, activity, space, time), of which there exists very few, are capable of conveying the true nature of a concept. Hjørland, however, judges (2013, 554) "rather problematic" the underlying philosophical assumption that elements of the discourse keep the same meaning in different contexts.

But the facet can also specify the role played by the concept, its function in a specific communication situation, the analysis and representation of a complex subject for instance. In this case, the allocating of a concept to a facet is determined by this concept's relationship(s) with others rather than by its nature. A single concept, whatever its nature, can play various roles in subject representation in the same way that a word can play different roles in different sentences. Kaiser specified early on (Svenonius 1978, 471) "that the syntax of expressions in a string indexing language could be defined with respect to an initial categorization of terms into facets." This conceptualization of the facet brings to mind linguistic techniques of discourse analysis, such as Fillmore's case grammar (Binwal 1992; Gnoli 2008a) and its extension into semantic frames (Green 2017).

Maniez believes that it is Ranganathan, again, who brought about this distinction when he prescribed the indexing formulas that assign a specific function to each concept in the context of subject representation. Maniez emphasizes that Ranganathan's "personality," "matter" and "energy" facets are simultaneously fundamental and functional. He suggests that Ranganathan made a bold move when he merged semantic (paradigmatic) and syntactic categories into the single concept of facet and proposed his PMEST formula as the absolute syntax (1999).

CRG members insisted on the importance of the functional dimension of the facet by demonstrating that the same entity did not belong to the same grouping (or facet) in different disciplinary environments; straw, for example, is an "entity" in botany, a "material" in construction, and a "product" in agriculture. In the CRG list of thirteen categories (thing/entity, kind, part, property, material, process, operation, patient, product, by-product, agent, space, time), the majority are indeed functional; in the representation of a subject, some of these categories have no meaning if not related to another (e.g., an agent exists only in relation to a process or an operation) (Broughton 2001). This view of facets as roles is articulated by Jason Farradane, for whom concepts have no semantic value (Broughton 2013). Both Mills (2004) and Vickery (2008) confirm that there exist two distinct types of facets: fundamental facets (living being, time, matter, etc.) and relational facets (agent, type, part, product, etc.) In his presentation of the extraordinary contribution of Vickery to the theory and practice of classification, Eric Coates insists that, in the eyes of Vickery, facets were more unambiguously presented in relation terms (Gnoli adopts a predicate logic approach to describe facets as (2006, 14-15) "the relations typical of a phenomenon with other phenomena: plants typically have organs (roots, stem, leaves, etc.), are in some growth stage (seed, bud, adult, etc.), can be affected by some disease (smut, peronospora, oidium, etc.), live in some habitat (desert, meadow, forest, etc.)"). In Gnoli (2017), he adopts an original perspective when he describes the various types of potential relations between concepts: the free or loose combination, the phase relation (bias, comparison, difference, influence), the grouping into categories (categorial relations), which, if they appear in a freely-faceted system, will have a semantic value, while they will be seen as syntactic relations in classical faceted systems and finally common facets, independent of disciplinary contexts.

In a system structured around functional facets, a concept is allowed to play different roles in different contexts all the while preserving its essential characteristics. In law for example, the same concept can represent the action at the heart of a particular court case, while being an element of context in another: the accident is at the heart of the legal decision where the issue is one of responsibility, but it belongs to the context where the court has to judge the fairness of a sanction imposed to a worker delayed because of said accident (Hudon and Fortier 2018).

Maurice Coyaud and Gardin are, according to de Grolier, the two theoreticians who may have contributed the most to the development of the syntactic role of the facet. Coyaud defines the facet as (Grolier 1965, 102) "any class of terms which is determined, not in relation with a hierarchy, but in relation with the various functions that these sets of terms may have among themselves on the syntagmatic axis." Gardin believes (Grolier 1965, 158) that "the facets are primarily a system of syntagmatic organization," and that the faceted systems "tend to impose one, and only one order, predetermined, in the syntactic relationships established between the indexing terms." In a similar fashion, Ingwersen and Wormell refer to facets "as roles or cases" (1992, 191), postulating that "by dealing with cases/roles, more or less identical to facets, [automatic] linguistic analysis might indeed be applied" (1992, 195).

Broughton (2006) offers her description of the nature and/or function distinction when she talks about intra-facet relationships (semantic relationships) and inter-facet relationships (syntactic relationships). Intra-facet relationships exist between concepts of the same or similar nature often linked hierarchically. Inter-facet relationships associate terms from different facets to create subject representations. Frické asserts that facets are required to be orthogonal and independent, explaining (Frické 2011, 493) that "when constructing a synthesized value, the choice of a focus or isolate from one facet has no repercussions whatsoever for combination with a focus from another facet."

In their work on the *Nuevo Soggetario,* Cheti and Paradisi shadow Ranganathan's footsteps in their attempt to combine semantics and syntax. They identify a set of facets and categories to which terms in the thesaurus belong and provide a scheme of the roles they can play within a subject string, specifying (2008, 231) that "role analysis is based on the syntactic valency of a term, rather than its categorial membership;" Gnoli describes this as (2008a, 128) "applying facet analysis, in the form of a scheme of roles, to the revision of the [Italian] national subject heading list." In this project, semantic relationships founded on the meaning of terms are called *a-priori*, document-independent relationships; functional or syntactic relationships associated with concepts in a subject statement are *a-posteriori*, document-dependent relationships (Cheti and Paradisi 2008).

4.3 Object vs subject

The unresolved ambiguity surrounding the notion of facet may have much to do with the type of entities described and/or categorized: physical objects such as commercial goods, museum artifacts or library documents or abstractions such as the components of a subject in a subject heading (Maniez 1999).

Ranganathan links facet and subject when he refers to the facet as a generic term designating any part of a complex subject (Gnoli 2008a; LaBarre 2010a; Maniez, 1999). Harter (1986) and Foskett (2009) explain that facet analysis denotes the technique of isolating the various elements of complex subjects. Hjørland (2013) defines all five of Ranganathan's fundamental categories with respect to a subject: "personality" is the distinguishing characteristic of a subject, "matter" is the physical material of which a subject is composed, "energy" is any action that occurs with respect to the subject, "space" is the geographic component of a subject and "time" is the period associated with a subject. The arrangement of the categories, or facet order, constitutes a (Hjørland 2013, 547) "ranking of the importance of the five dimensions of each subject according to decreasing concreteness."

Over the past three decades, however, the number of applications of facet theory to the description of concrete objects has grown exponentially. It is of interest to note that the meaning attributed to the term facet in such context is in fact closer to the original meaning of the term as given in lexical sources. The Art and Architecture Thesaurus (AAT), for example, is structured around seven facets (associated concepts, physical attributes, styles and periods, agents, activities, materials, objects) and it is widely used to describe various types of art objects and museum artifacts. In library catalogues, the association of facets to documents as objects is best illustrated by the now common use of the term facet to designate those elements of the bibliographic record that can be applied as non-semantic filters at the time of searching: authors' names, original language, date of publication, collection, etc. Frické (2013; 2017) offers the concept of "ersatz facet" to qualify simple attributes of objects or phenomena that do not connect them with others the way real facets do. In an extended research paper, Boutin (2008) uses this conceptualization of the facet to develop an original approach to web page description, indexing and evaluation. His proposal recognizes the importance of thematic content but also that of content presentation. Boutin recommends that the following form-related facets be applied to the description of web pages: polarity, degree of subjectivity, readability level, accessibility, centrality (2008, 195), admitting that this view of facets has indeed little to do with Ranganathan's canons and principles.

Broughton (2006) believes that a reference in NISO Z39-19 to facets as attributes of content objects has done much to legitimize the practice. Both Broughton (2006) and Gnoli (2008a) view this as a loose interpretation of the faceted approach, more common in North America than in Europe. LaBarre ascribes this interpretation to the fact that, at the time, "North American use of facets [had] been largely confined to small domains to provide access to objects (not concepts) in commercial or business applications" (2008, 105), with KO specialists slow at first to join the movement.

Vickery appears to dismiss the concerns of his British colleagues about the distinction between facets of objects and facets of subjects by stating that they can both be represented by symbolic terms (notation) (LaBarre 2011). Even members of the Indian tradition, known for their attachment to Ranganathanian principles, see facets as aspects of multidimensional entities, whether subjects or carriers of knowledge (LaBarre 2011, quoting Raghavan 2010). Broughton accepts all interpretations when she states (2001, 88) that "categories can be based on whatever attribute of *documents/subjects* (our emphasis) need to be identified for indexing and retrieval purposes." Although the distinction does not appear to decrease the efficiency of information systems, one may wonder if it is wise, or even possi-

ble, to use an integrated set of facets to describe a physical object, represent a subject and structure a discipline.

This third conceptualization of the facet, as either a template to describe an object or a basis to represent and rank the constituent parts of a subject, heralds another significant distinction between facets whose function it is to organize (a collection for example) and facets used to facilitate navigation, identification and retrieval in commercial or bibliographic databases.

4.4 Organization vs navigation

Even at the end of his long life, Ranganathan could hardly have imagined a world where computers would become freely available to everyone, with all types of documents accessible at a distance. For him and for his contemporaries, the purpose of faceted classification was the physical organization of materials, and the efficient representation of complex contents for browsing and physical retrieval (Broughton 2013). The complexity of the *CC*, however, prevented its adoption in libraries where it could not displace the well-entrenched decimal structures.

Following in Ranganathan's footsteps, twentieth century KO specialists concentrated their efforts on finding the best use to be made of facets to classify documents and organize physical collections. Their focus remained on hierarchies, notation and citation order, and they expended much energy in describing the design stages of faceted structures that would often end up being quite similar to their enumerative predecessors. While they were busy looking for the ideal classification system, other parties discovered Ranganathan's approach, recognizing the potential of facets to describe and explore more or less structured digital contents. Facets came to be seen as essential keys for discovery, allowing for browsing refinements and altogether more effective searching.

In the digital world, the concerns in managing the information store "are not those of arranging the material, but rather of adequate object description (labelling the items to support subject retrieval), providing search tools that support browsing, navigation and retrieval, and, to a more limited extent, the presentation of results" (Broughton 2006, 50). The first priority is to describe precisely all types of information objects. The second priority is the design of interfaces and search engines that will facilitate browsing, navigation, retrieval and presentation of results. Well-defined and functional facets specify the aspects on the basis of which an object or subject can be represented and retrieved, and the faceted structure contributes to usability and user-friendliness. It is interesting in this context to note that even if it is possible to discuss the concept of facet without reference to classification and classification systems, it is not essential to do so. The same facets (criteria, dimensions, aspects) used to generate subsets of entities (classes) can be used, conversely, to describe each entity without the necessity to preserve any link to its parent subset. For instance, gender, occupation, age and first language learned are facets used to group individuals; the same facets can be used to identify any single individual. This explicit way of describing facilitates retrieval by criteria without any obligation to apply syntactic rules (or citation order) or to know which class should be looked into (Hudon 2008). Hearst (2006) found that participants in empirical studies estimated that hierarchical faceted categories were preferable to unpredictable clustering, and Fagan (2010) stresses that facets as a refinement tool were generally appreciated by information searchers who rated the faceted system more highly, giving it significantly higher ratings for flexibility and relevance of search results.

The shift from organization to navigation in the use of facets started as early as the 1990s, when Windows technology expanded searching capabilities, including hybrid browse-and-select techniques and options displayed via drop-down menus. Pollitt took advantage of these functionalities to incorporate faceted structures and design what he called (Pollitt et al. 1998) "view-based searching." Search interfaces and navigation using facets in the critical role of filters took off early in the twenty-first century. In a search interface, facets can indeed perform several functions: vocabulary control, site navigation, expectation setting, browsing support, searching support, and disambiguation support (Fagan 2010). In a 2017 paper, Broughton highlighted many advantages of the faceted approach: numerous end-user features, clearer map of a domain, intuitive, capable of managing complex content and of facilitating visualization of complex content, good support for query formulation and for query modification and capacity to adapt to automatic search systems.

First applied in the design of commercial sites, facets were soon found in museum digital portals and in new generations of library catalogs (Broughton 2013; LaBarre 2006; LaBarre 2007; Maisonneuve and Touitou 2007). LaBarre (2008) sees 2006 as a turning point in North American libraries, when North Carolina State University (NCSU) implemented the faceted or guided navigation system of Endeca software in its local catalog (OPAC). Practitioners soon considered faceted navigation as central to applications that were fast developing, allowing users to view the items in any way they wanted rather than forcing a single, pre-determined way to access a collection (LaBarre 2006). In their article explaining how to develop a faceted classification structure, Broughton and Slavic suggest (2007, 749) that the vocabulary collected and organized into facets can assist in the creation of a search interface "in which the user will be able to select verbal terms from different facets to determine more precisely the subject he/she is looking for, and

without needing any knowledge of the complexity of the underlying system." Boutin (2008) considers this as a concrete manifestation of the evolving user-centered paradigm in LIS. At the time, library applications were greatly inspired by commercial ones, and LaBarre (2007) wondered if the assumptions embedded in commercial systems designed to provide access to concrete items with a view to enhance profit, "the simplest examples of faceted tools" (Broughton 2013, 742), were appropriate as a basis for library software. Facets used on commercial and on library sites certainly needed to be different. Discovery tools currently used in academic libraries are a hybrid manifestation of faceting; initial results are achieved by keyword searching and presented within frames enumerating various facets (author, date of publication, format, location, and language as well as subject per se) from which controlled terms can be selected to refine the search (Broughton 2013).

It is assumed that subject access based on faceted classification "offers more powerful and flexible information browsing and searching, and that this approach is particularly well suited for resource discovery on the Web" (Slavic 2008, 257), including within tagging applications (Spiteri 2010). LaBarre notes that, even if their use of facets appears to be efficient, information architects and knowledge managers remain largely ignorant of the theory, principles and postulates regulating the development of faceted structures (LaBarre 2007); indeed, many admit that they can hardly imagine facets outside a navigation or search systems (LaBarre 2006). This could explain, at least partly, why faceted navigation systems, whether commercial or library-based, are rarely associated to a faceted classification or even to a controlled vocabulary (Broughton 2006; Broughton 2013; Maisonneuve and Touitou 2007). Most employ categories as "a way of structuring the search interface, where they function as a browsing, and sometimes, filtering tool ... the categories or facets presented for use as a source of search terms, either alone or in combination" (Broughton 2013, 742); the choice of these categories or facets is contingent on "the domain, the nature of the terminology, and the needs and interests of users, rather than [on] any general philosophical or linguistic principles" (Broughton 2013, 743). LaBarre warns (2009, 21) that "if a designer is working with the superficial understanding that facets are simply equivalent to categories or database fields per se, it is far less likely that the resulting facets will be as powerful or useful as those that might have been produced through application of facet theoretical approaches."

5.0 Conclusion

The term facet is widely used by various communities of people involved in the exchange of goods and of information; in different contexts, it designates a category, a class, a cluster, a characteristic, a criterion, an aspect, a component, a filter, the chronological dimension expressed by a subdivision in a subject heading or a non-essential attribute, its price for example, of a product sold online. The ambiguity introduced by Ranganathan and maintained by the CRG and others authorizes such a wide appropriation of the concept and the simple definition of a facet as any kind of provisional or permanent grouping (Maniez 1999).

Svenonius (1978), Spiteri (2010) and LaBarre (2011) have called for explicit definitions of the term facet; along with Gnoli (2017), they worry that facet theory cannot move forward without a better sense of what a facet is and what it is supposed to do in an information or object retrieval system. Spiteri (2010) believes that definitions are needed if facets are to be derived and used consistently. LaBarre describes some consequences of the semantic ambiguity on the development of the SKOS model (2010a), and suggests (2010a, 103) that the creation of "operational definitions and functional requirements for facet theory may serve to enhance, amplify or extend current understandings and practices in Semantic Web implementations." Gnoli (2017) believes that a very broad interpretation of the term facet may result in the loss of awareness of the core principles and applications of facet analysis, a "basic requirement for any modern knowledge organization system (KOS)" (2017, 248). Mustafa El-Hadi suggests (2013, 22) that "the theory of facet analysis implies ideas which are still to be explored and to be fully utilised in the electronic environment," but it is unlikely that these can be uncovered easily without a clearer definition of the concept of facet.

Maniez (1999) has suggested that terminological refinements could clarify the contemporary discourse, proposing that the term facet always be associated with the qualifier "classificatory," so that it is recognized as a LIS concept. He then distinguishes two types of classificatory facets; categorial facets, applicable to any classification of concepts, regardless of domain, and structural facets, corresponding to the essential components of an entity or a subject (Maniez 1999, 261). Maniez connects categorial facets with the paradigmatic axis and semantic aspects of language, and structural facets with the syntagmatic axis and functional discourse. There would understandably be very few of the former but a great number of the latter, which would differ in each field of application. Though intriguing, such terminological specifications are not sufficient to solve the original ambiguity as to the nature and function of facets.

If there is little doubt that the ambiguity surrounding the term facet may impair communication among KO specialists, and between KO specialists and other concerned parties, it remains to be verified that this leads to significant negative consequences on information representation and retrieval. Research is needed to examine the actual impact of the phenomenon on the quality of retrieval.

Notes

1. Original in French: Catégorie de notions de même nature ou exprimées d'un même point de vue telle que phénomène, processus, propriété, outil, permettant un regroupement des notions indépendamment des disciplines traitées.
2. Capital letters and italics in source.
3. Original in French: Niveaux supérieurs d'une hiérarchisation des concepts obtenue par réduction successive du spécifique au générique.

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