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Indexing with images: the *imagetic* conceptual methodology

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Abstract

This proposal presents the methodology of indexing with images based on Peirce's semiotics. The indexing processes are analysed under the perspective of the sign both as a word and as image to show correlations between signs from literal and imaged universes. It is explained how the traditional indexing mechanisms are related to Peirce's semiotics in its simplified triad form of icon, index and symbol. Imaged indexing leads to more intuitive interfaces, an imaged KOS (iOPAC), improving the communication process throughout information systems. iOPAC would be a solution for supporting information access and navigation, language and concepts fostering better understanding and could pave the way towards semantic, social and cultural interoperability. Furthermore, the indexing methodology is analysed in line with the FRSAD model providing the entity-relational frame of reference for relating images to *nomens*.

1. Introduction

Digital libraries (DL) concept is evolving to an innovative understanding of institutions from a virtual realm that embodies in priority library concepts rather than technological apparatus, DL are intentionally closer to its users despite being at distance whilst adhering to principles of quality in services. That means DL is a set of characteristics identifying documentary organizations attempting to "associate immaterial with material (for example the OPAC¹), local with distant (open/close/semi-open client-server architecture) and visible with invisible (semantic data on the bibliographical notes)" (Papy, 2016, 13). Amongst a variety of initiatives, digital libraries have sought solutions to widespread information with effectiveness joining in its way the principles presented in the IFLA Internet Manifesto by the IFLA Committee on Free Access to Information and Freedom of Expression (FAIFE).

- Intellectual freedom is the right of every individual both to hold and express opinions and to seek and receive information; it is the basis of democracy; and it is at the core of library service.
- Freedom of access to information, regardless of medium and frontiers, is a central responsibility of the library and information profession.
- The provision of unhindered access to the Internet by libraries and information services supports communities and individuals to attain freedom, prosperity and development.

¹ Online Public Access Catalog

- Barriers to the flow of information should be removed, especially those that promote inequality, poverty, and despair. (IFLA, 2014)

Fox and Marchionini (1998) remember that thousands of digital libraries are emerging around the world, crossing all disciplines and media, ranging from the small, such as community organizations offering online catalogs and news for local constituencies, to the large, such as national libraries with a wide variety of research and cultural treasures in multiple media.

The pervasive power of digitization causes scientific, educational, economic and cultural communities to change their modes of accessing, sharing and disseminating knowledge. Besides, complexity and uncertainty from compulsive modernisation drive people to rely on information to perform their professional activities or to simply exercise their citizenship. In this social flow, the world became a great consumer of images because they are more effective in mass communication than written-only documents (Social Bakers, 2014; Asthon, 2015). Nowadays, it is extremely easy to find things on the web except for illiterate individuals. Initiatives supporting privileged contacts between people and books are valuable strategies for developing reading habits according to IFLA.

For many deaf people, mastery of the oral and written idiom is a particular challenge. Libraries should strive to acquire general materials that may be understood by as many of their clientele as possible. Additionally, libraries should build and actively maintain a collection of high interest materials which are written purposefully with direct and simple vocabulary and which are heavily illustrated where appropriate so that they may be easily understood by people who have yet to gain full mastery of the local oral and written language, including many deaf people as well as people from other linguistic minorities.(IFLA, 2000,18-19)

Semiotics shows that image is a communication language and people have natural competencies to assimilate linguistic properties from images to engage in a communication process, this resonates with prior linguistics theories. In fact, the grammar codes that govern imaged communication are easier understood by a larger public, although structurally more complex and less explicit.

Libraries are social spaces characterized by the gathering of informational objects in synchronicity with users' demands. In the process of information organization, and specifically in the step of content description, the (written) language is the code largely used to represent concepts.

Indexing with images consists in using images instead of key-words or descriptors, to represent and organize information. Profundity in discourse is a characteristic of the written language, yet its representation is only possible with elements of cognition. It is a complex process to make use of words to represent knowledge. Yet, text contents have been embodied by textual elements *per se* . Admitting the multidimensional characteristics of images to broadcast messages, this work proposes a different point of view in the communication perspective. It certainly means a shift on knowledge organization systems (KOS) and leads towards the achievement of social and cultural interoperability as defined by Mustafa El Hadi (2015). For example, in terms of knowledge organisation, the brain of a born deaf individual (Marschark et al., 2000; Mcevoy et al., 2004) does not create the same connexions as hearing individuals. They generate alternative logical networks to understand and interact with the textual (oral and written) society. Deaf people do not naturally classify information as our current systems of classification do. Despite their normal intellectual abilities, they do not develop the same aptitudes of reading and writing that the majority of students at (normal) school. However, concerning the pervasive imaged

world, deaf people attest far more awareness of images than hearing people. These observations lead to significant understandings of image perceptions. Evidences are that accuracy in image details identification is related to the ability of decoding imaged messages. Because messages are codes, frequently converted to textual systems, the decoding methods for imaged messages are the key for interoperability between written and imaged communication. Regardless of the predominant competence of deaf people in recognising images, society still cannot give them the freedom to evolve independently in our written world. There is potentially a bridge connecting messages from these distinct universes, establishing an authentic two-way communication process.

What hinders semantic and consequently cultural interoperability is that the degree of success that can be achieved in the integration of multiple knowledge representation systems or knowledge organization schemes is constrained by limitations on the universality of human conceptual systems. In contrast, considering that images are powerful communication skills, imaged KOS are potentially valuable "intercultural" interfaces for semantic interoperability which is one of the core elements towards cultural interoperability. In this sense, we support the idea that imaged KOS support translatability and additionally promote navigation within social and cultural diversity through their iconic interfaces. We will develop in the following sections the concept of the imaged online public catalogue (iOPAC)² as a KOS for accessibility in libraries, archives and museums.

To go further in developing the imaged KOS we will consider implementing it as a user-focused mechanism compatible with FRSAD (Functional Requirements for Subject Authority Data). FRSAD supports the idea that a work has subjects (*thema*), and a *thema* has one or more appellations *nomen*. *Nomen* is any sign or combination of signs (alphanumeric characters, symbols, sound, images, etc.) that a *thema* is known by, referred to or addressed as. FRSAD is focused on aboutness to provide a clearly defined, structured frame of reference for relating the data that are recorded in subject records and tailored to meet the needs of the users of these records, and to assist in an assessment of the potential need for a global information share and use of subject data, both within the library sector and beyond. While associated with topics, images can be interpreted as *nomens* within FRSAD conceptual model.

2. Linguistic elements

The information retrieval process involves a complex relationship between communicating and describing the language to express thoughts. In fact, what is needed is to represent materialized knowledge in a text by acts of language. This sort of representation applies methods to canalize intrinsic proprieties from language and from its grammar. Content transposition to a meta-language that uses images as representatives of this controlled (meta) language is what we are looking for.

² Work presented at ISKO-BRAZIL CONFERENCE (2015)

Intuitively we know that inside a text there is a signification (objects inferring knowledge). What is verified, however, is that those objects can be expressed by natural operations, which are difficult to represent artificially, such as reading. The essential criteria of modernity in information processing methods reside in innovative ways of solving problems, not necessarily in a sophisticated technology. In practice, indexing as it is known is a translation of lexical units drawn from language, or a syntactic translation reflecting the relationships between parts of the speech, the ones describing contents, the descriptors. It aims to represent the objects that the document is talking about, or in other words, what is said in the speaker's message. Although words are used to index contents, words from the natural language or from dictionary (morphemes) point only to their signifiers, not to referents. They do not have these characteristics of designing objects.

Words from the lexicon, the list of words from a documentary system, do not have the status of words from the language nor from the discourse. Words from lexicon do not design objects neither; they refer to an open set of objects with common characteristics. It is not possible to perceive the borders of this set of objects, and so it is difficult to identify referents, and connexions between lexicon words and the objects from the reality (extra-linguistic reality or imaginary). What separates lexicon words from words in terminology is a very subtle understanding that explains why there is often confusion between them.

Words in terminology³ introduce a notion of a boundary or "terminus" in Latin that gave the word "term". The French linguist Michel Le Guern (1989) explains that in the lexicon as in terminology there are words on both sides, but they are not the same words. The object "word" from the lexicon is a distinct reality, the lexicon processes words disconnected from the objects, while in terminology words are connected to things. Words in lexicography are considered as nouns but in reality they are predicates. They denote qualities, not substances; they refer to proprieties, not to substances; to qualities, not to objects. The presence of an object calls for a term to be integrated into discourse.

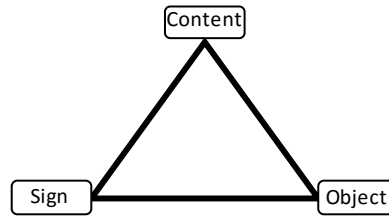
3. Semiotic contributions

For a long time the advantages of using images to transmit and receive messages have been investigated in semiotics. Advances in information technologies encourage important considerations about the information media. Literacy is essential, nonetheless we all read differently. The registered information is not only made by text, image has (re)conquered its place in communication. Interpreting imaged signs is as to reopen the gates of ancient temples reading stories through cultures and ages.

Traditionally, philosophical studies of sign refer to the semantic triangle illustrating the relationship between the sign, the content and an object.

³ Latin, boundary marker, limit — more at term. First Known Use: circa 1617. Source: Merriam-Webster's Learner's Dictionary

Figure 1- Semiotic Triangle



The semiotic triangle representation and its theoretical foundation can be traced back to Aristotle (Ogden and Richards, 1946, 11), who clearly distinguished objects, and the words that refer to them, and the corresponding experiences in the psyche.

In his pragmatism and logic, Charles Sanders Peirce (1839-1914) assumed that there is no immediate (without signs) perception of reality, so in the perception process everything is a sign including thoughts (Nöth, 2012). He claims that a sign consists of three elements, one of them is the sign, the second is the object to which a sign refers and the third, the most significant one, is an interpretant (Lefebvre, 2007). In its simplified triad form of icon, index and symbol, Peirce's logic explains that an icon represents an acquired experience from the past, a token from that experience, a portrait of a concluded moment. An index apprehends its experience from the present, it points to a thing, without giving any information about it. The symbol is the real fact that will be experimented in the future, at the very moment when the message arrives to the receiver and the formulated intensions are to be re-established.

Nöth (2012) explained that the idea is connected to what Peirce calls the "growth of symbols". The meaning of a symbol grows and develops through time as it is used in a culture. This growth is also augmented by the combination of terms in propositions as they then interact and change each other's meanings. The notion of time and changes in time have been analysed in various models of the communication process and scientific information transfer. Neelameghan and Narayana (2011) proposed different perspectives of expressing the time parameter in the field of information science. For them the qualitative and quantitative expressions of time are related to the issue of information quality or the desired features of information in the information system. Most often, there appear such qualitative characteristics of information as relevance, authenticity and timeliness. Timeliness of information is the ability to reflect the changing reality associated with time.

For Peirce, language and image compose the signs whose functions are embedded in the relations between the icon, the index and the symbol. When the roles of those signs are in balance, there is fulfilment. Peirce's theory is largely employed for image description purposes and in archival practices. The focus is on the description of an 'image-document' for further retrieval. In other words, instead of describing images, we are interested in using images as signs, replacing key-words with images for content description. This imaged representation presupposes a different navigation approach for the KOS and a mainstay within Peirce's theory to support the whole. For Peirce each object is in relation with a number of other objects from the same universe, directly or indirectly, in such a path that each element carries within itself an undetermined indicial potential.

How then a sign can represent an object and reveal it itself? The iconic representation is a quality that emerges from the object in order to identify it as it is. Signs leading to inferences over true realities are the ones that make possible indexing with images principles as explained by De Brito and Caribé (2015).

The emerging 'key-image' concept means substitution or equivalence with the key-word concept commonly used to describe subject contents. The procedure of intentional construction of images of this model is inspired from Jacques Bertin's (*apud* Dantier, 2008; Bertin, 1970) works in which he demonstrates that image composition follows the rules of linguistic semiotic. For this author, every thought is expressed throughout a system of signs imitating a natural codification. The verbal language is a code of audible signs, the writings of a language are another kind of code, and so it is a graphic representation. So, if a graphic representation is a transcription of information from a graphic system of signs, then it has to be considered as a semiotic matter.

For Bertin a graphic representation might have three basic functions: register, communicate and process information. Indexing with images anticipates a moment of lecture and another of creation. It results in building an image (a chart) able to communicate a thematic message corresponding to the document's contents. In comparison to the key-words, the result of indexing with images is not a simple selection of images subjacent one to another, but a chart of significative images intentionally composed to become the key-image of the document. These indexing images are made of a set of iconic, indicial and symbolic proprieties (transmitted or inherited) to represent the document. This new composed image, gathering multiple semiotic traits, has itself a new symbolic interpretation.

4. Functional Requirements for Subject Authority Data (FRSAD)

IFLA proposed in 2010 a new bibliographic infrastructure to support global sharing and reuse of subject authority data, the FRSAD model. Aboutness is the FRSAD focus to provide a clearly defined, structured frame of reference for relating the data that are recorded in subject records. Žumer, Zeng and Salaba (2012), show how this structure is tailored to meet the needs of the users of these records and to assist in an assessment of the potential need for a global information share and use of subject data both within the library sector and beyond.

The scope of the FRSAD was defined in the following terms of reference:

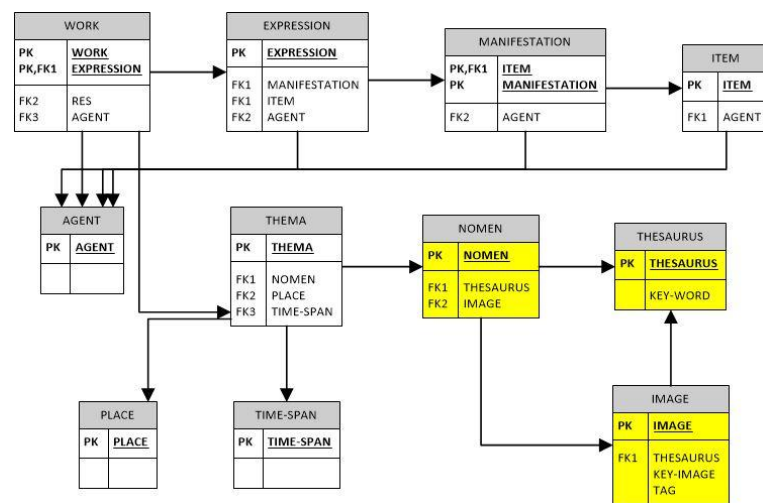
- To build a conceptual model of Group 3 entities within the FRBR framework as they relate to the aboutness of works;
- To provide a clearly defined, structured frame of reference for relating the data that are recorded in subject authority records to the needs of the users of that data;
- To assist in an assessment of the potential for international sharing and use of subject authority data both within the library sector and beyond.
(Salaba, Žumer and Zeng, 2011, 9)

According to Gemberling (2016) one of innovations is to extend FRSAD's element *nomen* to apply to Groups One and Two as well as subjects. *Nomen* is "any sign or arrangement of signs by which an entity is known." The author reminded that *nomens* are the "symbols," in Peirce's sense, which we use to represent things.

In FRSAD model a work has a subject *thema*, and a *thema* has a appellation *nomen*. *Nomen* is any sign or combination of signs (images inclusive). FRSAD presents four subject authority data user tasks. Find to find an

entity (*thema* or *nomen*) or set of entities corresponding to stated criteria. Identify to identify an entity (*thema* or *nomen*) based on certain attributes or characteristics. Select to select an entity (*thema* or *nomen*). And explore to explore any relationships between entities (*thema* or *nomen*), correlations to other subject vocabularies and structure of a subject domain. A *nomen* can be human-readable or machine-readable. *Nomen* is a superclass of the FRSAD entities name, identifier, and controlled access point.

Figure 2- FRSAD Relationships



Source: adapted from Riva and Žumer (2015)

FRSAD Entity-Relationship conceptual model (Riva and Žumer, 2015; Salaba, Žumer and Zeng, 2011,15) postulates that “has appellation/is appellation of” relationship is in general many-to-many. A *thema* has one or more *nomens* and there may be a *nomen* referring to more than one *thema*. In addition the diagram above shows how *nomens* are related to images (key-image descriptors) and traditional relationships with thesaurus. Images can be tagged with entries from thesaurus (Gheorghita, 2011; Aitchison and Clarke, 2004) or with external social tags, such as from folksonomies.

As a result the relational model illustrates that *key-images* (tailored made) are tagged as well as original images explaining inheritance from concepts embedded in images, what ensures wider semantic fields for imaged descriptors and sense integrity throughout the indexing process. Moreover, the same integrity improves KOS functions and information retrieval quality in interoperability perspectives

In the Appendix C of FRSAD’s report Salaba, Žumer and Zeng (2011, p. 49) have presented the importance of the efforts to achieve global sharing and use of subject authority data, most efforts have focused on *nomen*. Such efforts usually encounter much greater challenges because they are concerned with the subject mappings in terms of their meaning as well as the relationships among the subjects.

By following interoperable web design principles, such as the use of RDF and XML, this proposal sought to create an *imagic* model that could be integrated into an OPAC system potentially supporting a variety of uses, including query expansion in search, resolving ambiguous subject use in resources, and promoting serendipitous discovery of new links among and between documents. In short, to access, convert, or reuse web content from a variety of domain-specific and general resources.

5. The imaged online public access catalogue (iOPAC)

To reformulate OPACs, under this imaged indexing initiative, this will involve not only IT solutions but also giving answers to epistemological questions inherent to the nature of images. The procedure of using images to describe documents is not free of impacts. Besides, Papy (2016, 57) observes that it is imperative to meet the users' needs by rethinking the design of devices and stopping privileging the technological orientation.

Structurally, while looking for a specific document using the iOPAC interface, the user's behaviour first tends to recognize the conceptual relationship between images and objects (image-subject/document-subject), then he uses this cognitive mechanism to find the object (a book) or set of objects he is looking for. In a second case, the user has an information need, but ignores that there is an object (or a set of objects) that could meet his need. He tries first to match needs to images, and then to verify inside the collection of documents if there are connexions of the same kind, repeating the first case above.

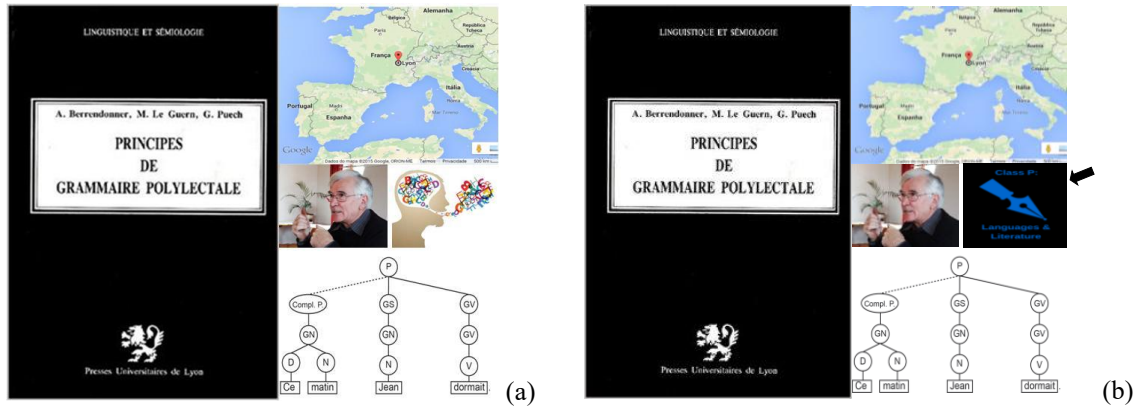
Implementing the imaged navigation in OPACs denotes multiple advantages derived from this. The iOPAC has a greater visual attraction pushing users towards the catalogue; a more intuitive comprehension of indexing codes, a larger conceptual portability of descriptors (as images), and a better interoperability between discourse codes and indexing competences affecting positively social and cultural interoperability.

Applying the imaged concept to *nomen* in the FRSAD model is rethinking the catalogue anew, since we are looking forward to sharing concepts within the subject authority data. This happens when images, carrying linguistic objects, permeate inter-social and cultural concepts. In practice it includes translated metadata, symmetrical multilingual thesaurus, or any traditional indexing tools.

In contrast to side by side affecting key-words, the result of indexing with images is a chart of significative images intentionally composed to become a key-image representative of the document. The key-image composition follows Peirce's instructions concerning the "complete sign". The iconic element is chosen, as close as possible, from the cover book or a picture of the object-document (because there are documents without cover). As this resulting image is restrained to small dimensions, it cannot contain all (sub) images we would desire to represent the document, thus the priority is given to the following logic axes: the cover image, a geographical localization, and a temporal or thematic reference (De Brito and Caribé, 2015).

The following *imagic* examples show these principles in practice:

Figure 3: Example 1 (a,b) - BERRENDONNER, Alain; LE GUERN, Michel; PUECH, Gilbert. Principes de grammaire polylectale. Presses universitaires de Lyon, 1983.

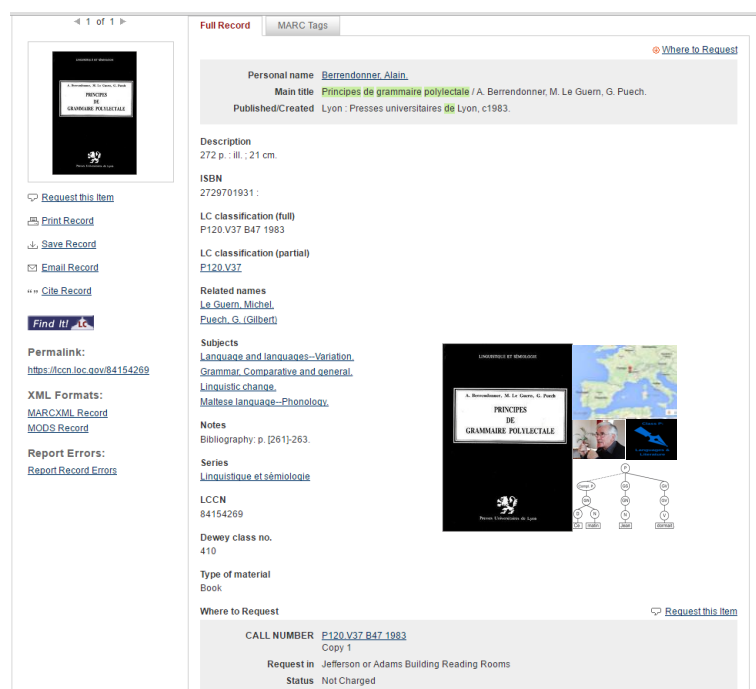


Source: De Brito and Caribé (2015)

Collages (a) and (b) follow the previous directions; however it is to be noticed the absence of temporal indication in this case, as part of a indexing strategy admitting this attribute is less important for this document. In the variation (b) the sign for “communication” is replaced with a theoretical concept of Library of Congress Classification (Class P - languages & literature) giving to the key-image a suggestion of knowledge domain, in substitution of a thematic trait (human communication) present in case (a). These reasoning choices are examples of specific strategies related straight to users’ profiles.

As the key-images can work as key-words for retrieval purposes, this book could be located using a traditional (written) query or an imaged one. In both cases the search would be naturally improved by the iconographic support of the key-image, meaning references to the book cover, to France, to tree grammar representations, and to the authors’ image, all references absent in the document description as showed below.

Figure 4- Book record simulation with key-image indexing



Source: Simulation study on Library of Congress' OPAC response (<https://catalog.loc.gov/index.html>)

The iOPAC embodies efforts focused on conceptual levels as expected from librarians. Also, model implementations have encountered challenges during its validation regarding methodology of mapping concepts in images or establishing conceptual relationships among subjects and classification systems. Yet, these are nothing but imminent issues for future research.

As Papy (2015) observed, the flexibility of the interoperability of Web applications borne by XML technologies and generalization of dynamic web, the possibilities of adapting the final form of an XML document, building it or transforming it are, essentially limitless. Personalized virtual documents (PVDs) which are largely composed of all kinds of fragments, extracted from different information systems, possibly hosted on distant machines, have no predefined size or form. "Digital libraries lend themselves to the extraction of such fragments: a video resource extracted from an AV resource portal can be integrated into a resource with articles from different reviews portals and bibliographical elements from online catalogs" (Papy, 2015: 93). He added that, "The digital document in digital libraries is a technological document which is indissociable from ICT that implements it. This document, which introduces combinatorial diversity of the content, redefines the relationship between content and usage. The form – the presentation which cannot simply be reduced to the page setting or the formatting of the characters – carries with it a diverse set of SEMIOTIC usage values", (Papy 2015, p. 103-104).

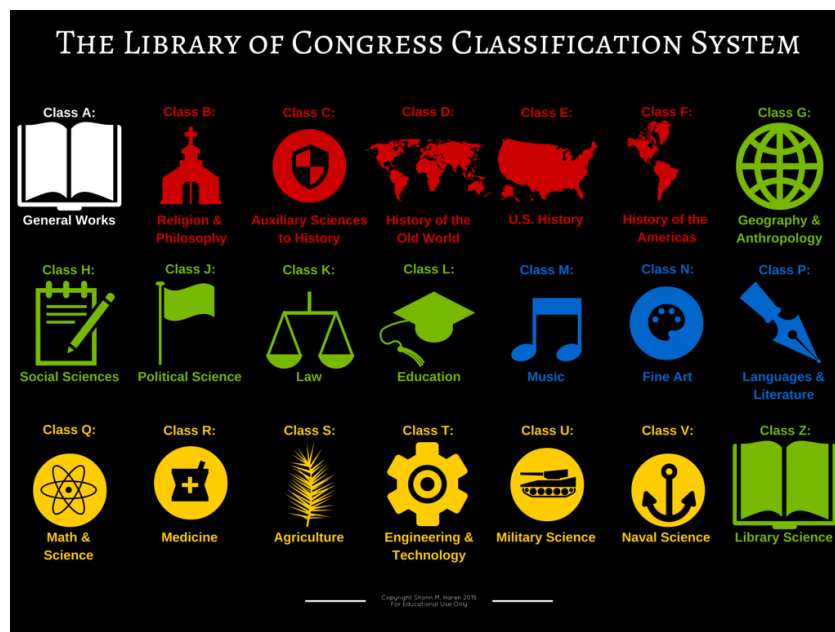
In the graphic interface, the user's query progress in a faceted hierarchic sequence of images choices. The cascade navigation rolls down to sub-classes inside the catalogue until reaching the most profound hierarchical

level, the one in which the user finds the wanted documents. The facet display represents personal and corporate images, geographic maps, time periods, topics and others.

The facet defines the interest domains; the navigation progresses by examining representative domain material or collecting images that reflect domain interests, then sorting images into homogeneous, mutually exclusive groupings (facets). Facets are structured in hierarchical order to coalesce synonyms, identify misaligned signs and gaps in the system.

The Library of Congress Subject Headings has been assigned to a simplified list of signs making the classification schema easier for users to understand, apply, and reuse. Any valid set of Library of Congress' icons can be converted to subject headings.

Figure 5– Library of Congress catalogue icons



Source: https://commons.wikimedia.org/wiki/File:The_Library_of_Congress_Classification_System.png

Navigation in this perspective allows a variety of possibilities combined into written and imaged queries. Clicking on an icon, the KOS performs a visualization of the underlying thesaurus expanding the desired categories associated within the local network of semantic relationships. The mechanism takes advantage of *nomens* functionalities throughout the relationships of FRSAD model. Such an application supports accessibility for functional illiteracy and endorses social and cultural interoperability. In a sense of interpreting images is an intuitive ability iOPACs are cross-cultural tools that enhances the retrieval information process and promotes the reading experience for a larger population, and so doing iOPACs are empowering libraries to accomplishing their social and cultural mission.

6. Final considerations

Indexing with images leads us to question the current paradigms about using key-words to describe document contents. The key-images involve a legitimate approach to index documents with multiple perspectives in technical, professional and social areas. We can perceive changes in documentary retrieval fields, when enhanced with universal KOS based on imaged communication, and no longer contained by a specific written language. This contribution to knowledge representation is supported by semiotic theories and presents a new approach for documentation which needs to be tested in large scale of documents and users.

Web search engines may use these alternatives of indexing techniques to support KOS performance. A broader area for interface development is now available with effective benefits for handicapped users, such as deaf people, groups with functional illiteracy in general or in the sense of multicultural interoperability. In short, the use of images to create links between people and documents would meet KOS challenges in a prosperous scientific ground.

Textual descriptions of images, as suggested in semiotics, are at the origins of the principles of indexing with images. Bertin's orientations explain how to compose imagetic charts according to linguistic theories and therefore with the mechanisms of image indexing.

Interdisciplinary fields, such as neurosciences, linguistics and information sciences are invited for contributions in order to explore the nature of cognitive process, the autism communication grammars, the effects of bibliotherapy in ageing persons with reading barriers or in patients with Alzheimer.

The examples of iOPAC navigation might inform us about the viability of this model. The results illustrate alternatives for accessibility in libraries, archives and museums. The target public finds amplified opportunities to improve reading practices, and librarians discover new competences with countless benefits for users and information systems.

In addition, the Imaged model, can be implemented as a user-focused mechanism compatible with FRISAD. We believe that the Imaged methodology can offer new possibilities for considering semantic, social and cultural interoperability when using OPACs.

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