Towards a conceptual framework for user-driven semantic metadata interoperability in digital libraries: a social constructivist approach

Getaneh Alemu (MSc), Brett Stevens (PhD) and Penny Ross (PhD)

University of Portsmouth, Portsmouth, UK

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Abstract

Purpose – With the aim of developing a conceptual framework which aims to facilitate semantic metadata interoperability, this paper explores overarching conceptual issues on how traditional library information organisation schemes such as Online Public Access Catalogues (OPACs), taxonomies, thesauri, and ontologies on the one hand versus Web 2.0 technologies such as social tagging (folksonomies) can be harnessed to provide users with satisfying experiences.

Design/methodology/approach –This paper reviews works in relation to current metadata creation, utilisation and interoperability approaches focusing on how a social constructivist philosophical perspective can be employed to underpin metadata decisions in digital libraries. Articles are retrieved from databases such as EBSCO host and Emerald and online magazines such as D-Lib and Ariadne. Books, news articles and blog posts that are deemed relevant are also used to support the arguments put forward in this paper.

Findings – Current metadata approaches are deeply authoritative and metadata deployments in digital libraries tend to favour an objectivist approach with focus on metadata simplicity. It is argued that unless information objects are enriched with metadata generated through a collaborative and user-driven approach, achieving semantic metadata interoperability in digital libraries will remain difficult.

Practical implications – In this paper, it is indicated that the number of metadata elements (fields) constituting a standard has a direct bearing on metadata richness, which in turn directly affects semantic interoperability. It is expected that this paper will contribute towards a better understanding of harnessing user-driven metadata.

Originality/value – As suggested in this paper, a conceptual metadata framework which is underpinned by a social constructivist approach substantially contributes to semantic interoperability in digital libraries.

Keywords Metadata, Semantic metadata interoperability, Social constructivism, Digital libraries, Web 2.0, Semantic Web, OPAC

Paper type Conceptual paper

Introduction

Contemporary metadata standards (such as MARC, Dublin Core, MODS, DDC, and Library of Congress (LC) classification and LC Subject Headings) and metadata interoperability approaches (such as metadata cross-matching, metadata derivation, and metadata registries (Chan and Zeng, 2006; Dekkers, 2002; Nagamori and Sugimoto, 2006; Nilsson, 2010; Zeng and Chan, 2006)) are mainly authoritative and hierarchical (Veltman, 2001; Weinberger, 2007; Shirky, 2005) which tend to favour an expert controlled metadata approach that is ubiquitous in current library practises (West, 2007). Such authoritative standards are criticised for failing to take into account the diversity of cultural, linguistic and local perspectives that abound in library users (Veltman, 2001; Shirky, 2005; Weinberger, 2007). With the advent of social media and web 2.0 technologies (O'Reilly, 2005), a collaborative information organisation approach, referred to as folksonomy – a term coined by Thomas Vander Wal in 2004 (Vander Wal, 2007) – has emerged and is currently in widespread use in popular web applications such as Wikipedia, Flickr, LibraryThing, Delicious, and Technorati. The effect of the web 2.0 phenomena on markets, day-to-day life, education and access to information is widely recognised (Anderson, 2009; Weinberger, 2007; Anderson, 2006). However, libraries are grappling with the problems of integrating user-driven and social media approaches in their major functions. Standards-based metadata on one hand and non-hierarchical and user-driven ones on the other are often presented as dichotomies, albeit mistakenly (Gruber, 2007; Wright, 2007). While concerted efforts have been made by libraries to introduce some aspects of web 2.0 services (Maness 2006; Casey and Savastinuk, 2006; Miller, 2005; Collinson, 2009), their use in metadata creation and information organisation is very limited or non-existent. The problem can partly be attributed to an absence of theoretical and conceptual metadata frameworks that serve as a basis for a better understanding as to the use of web 2.0 services. To overcome this, in this paper, it is proposed that a social constructivist approach should be adopted by libraries and other cultural heritage institutions when archiving information objects that are required to be enriched with metadata, thereby reflecting the diversity of views and perspectives that can be held by their users. In line with this, it is argued that libraries should embrace and harness collaborative metadata approaches. It is argued that, the solution towards metadata interoperability does not lie in developing a set of standards on top of existing ones. Lacking in current metadata discussions are theoretical and conceptual foundations that underpin the creation and utilisation of metadata. It is along these lines that, a conceptual metadata framework – aimed at contributing towards the semantic interoperability of disparate digital libraries – is suggested in this paper.

Adopting a social constructivist philosophical perspective

The development and use of controlled vocabularies, authority names, taxonomies, and classification systems is predicated on prior assumptions made about the language (keywords) that users would use to search and browse digital libraries (Shirky, 2005; Weinberger, 2007). These tools contain fixed categories that are updated at wide intervals. Consequently, the terminologies are likely to be out-dated and missing context through time, and hence failing to represent users' world views adequately. As Shirky (2005) indicates, the tension between hierarchical and collaborative categorisation comes down to a philosophical question, i.e. "does the world make sense or do we make sense of the world?" According to him "if you believe the world makes sense, then anyone who tries to make sense of the world differently than you is presenting you with a situation that needs to be reconciled formally, because if you get it wrong, you're getting it wrong about the real world".

Taking the view that reality is contingent on people making sense of the world, the main contention in this paper is that current metadata practises are mainly authoritative, hierarchical and stem from a foundationalism (objectivist) ontological viewpoint. Such a position as this, ontologically speaking, can

only advocate a single solution to problems. It is worth noting that, though not explicitly stated in their policies, metadata agencies such as MAchine Readable Cataloguing (MARC) and Dublin Core can be considered as examples of such authoritative approach. As recommended by Guba and Lincoln (1994), Grix (2004), Creswell (2003) and Charmaz (2006), scholarly investigation should lay its foundation on the building blocks of research. The philosophical perspectives as to whether the investigator has adopted a positivist or interpretive paradigm should also be explicitly stated at the same stage. Therefore, in accordance with the above, it is felt that a thorough examination, and in-depth understanding, and a clear statement of the underlying ontological and epistemological perspectives will help re-evaluate the existing metadata standards and metadata interoperability solutions.

According to Crotty (1998) constructivism "posits that all meaningful reality is contingent upon human practises, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context." The underlying assumption is that meaning is constructed and shaped from objects with the active engagement of the observer/researcher. According to Duffy and Jonassen (1992), social constructivism posits that "meaning is imposed on the world by us, rather than existing in the world independently of us. There are many ways to structure the world, and there are many meanings or perspectives for any event or concept." This is contrary to the objectivist view that "truth and meaning reside in their objects independently of any consciousness" (Crotty, 1998).

One may question the relevance of social constructivism for semantic metadata interoperability. Semantic interoperability, by definition, deals with problems associated to information sharing and exchange. The goal of semantic metadata interoperability is to enabling information sharing and exchange through negotiated meanings of the terms and expressions (Veltman, 2001). The nature of knowledge in social constructivism focuses on "individual reconstructions coalescing around consensus" thus promoting shared and negotiated meaning (Guba and Lincoln, 1994). Social constructivists assert that "realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature, and dependent for their form and content on the individual persons or groups holding the constructions" (Guba and Lincoln, 1994). Recent developments such as the shift towards web-based publishing media – Wikipedia, the spread of social tagging, and the adoption of social networking applications, and an overwhelming move towards the acceptance of disparate points of views and negotiated meanings, as well as a general, implicit, tendency to arrive at a neutral point of view – all point to a need for embracing a social constructivist perspective. Recognising and accepting the existence of multiple interpretations of an object obviously has a bearing on semantic metadata interoperability as it implies and accounts for differences in the interpretations of digital objects (information resources) among individuals, groups, countries and geographic regions.

Plethora of metadata standards

Significant investments have been made to specify metadata standards (schemas) by a number of national, multinational and international initiatives in order to characterise their collections of information objects for the purposes of discovery, management or preservation (Anderson et al., 2009; Day, 2001; Gartner, 2008; OCLC/RLG, 2001). These standards exist alongside local standards, many of the latter, although almost unknown by the wider literary community, have been adopted by individual institutions. Based on current trends, it is reasonable to expect that the situation will continue to become more complex as time goes on. Each of these standards requires implementers to adopt and adhere to some kind of a naming scheme, an identification mechanism, a controlled vocabulary, an authority control, and an encoding scheme. The plethora of such local and international schemas leads to several common problems, including imprecise definition of terms, ambiguous characterisation of metadata

elements, as well as incomplete or otherwise incorrect identification protocols, conventions and encoding schemes (Haslhofer and Klas, 2010). The diversity of metadata standards, the existence of local schemas and the heterogeneity in metadata usage and implementation has significant implications for institutions that strive to provide seamless and integrated access to information resources when they attempt to share and exchange metadata, as well as, content across heterogeneous digital libraries.

Interoperability challenges

For digital libraries, achieving metadata interoperability, at present, is a big challenge (Miller, 2000; Chan and Zeng, 2006). The ideal solution to metadata interoperability difficulties would be the adoption, strict adherence to, and consistent implementation of a single standard by all digital libraries (Chan and Zeng, 2006). The Anglo-American Cataloguing Rules (AACR), MARC and Dublin Core are notable examples of such attempts to finding a single universal solution. The underlying assumption, in all of these three standards and similar ones, has been that cultural heritage institutions would eventually coalesce around a single metadata standard, hence clearing the way for achieving interoperability among various information systems. Major proponents of such a authoritative solution include Melville Dewey (Veltman, 2001). Similar views, regarding the organisation of digital information systems and the establishment of standards that govern their operations, are still being propagated widely. Veltman (2001), on the other hand, argued that the search for a single, ontologically true, metadata solution does not reflect the pragmatic reality that prevails at different institutions. As he contends many of the international metadata initiatives focus "more on the universal meaning of the basic fields or elements (containers) than on the local and regional contents in those fields or elements." The question as to why all libraries do not just use a single standard might arise. The problem is related to the fact that libraries are cultural heritage institutions and culture is a fluid phenomenon. The latter's fluidity makes it difficult, if not impossible, to provide objective definitions and explanations to objects. Libraries and archives provide lodgings to cultural information objects such as paintings, photographs, writings, as well as physical ones (e.g., the Rosetta stone at the British Museum). By their very nature these objects convey different meanings for diverse user groups, and hence, can be interpreted variously. Put simply, human beings are highly unlikely to agree on a singular, authoritative and hierarchical classification of objects. This assertion is likely to assume increasing importance when it comes to how museum objects, such as paintings, are depicted and interpreted. Thus, information organisation systems, such as metadata standards, should be able to reflect the various interpretations of reality. Unfortunately, most current standards tend to adhere to what is known as the ontologically and objectively true viewpoint, which fails to capture and represent local and/or regional perspectives and interpretations.

At present, most libraries provide very little information regarding the semantics and subjective aspect of information objects. This is due to, first of all, the fact that standards agencies are mainly concerned about the physical characteristics of an object. Secondly, librarians are not always experts at adequately describing the semantic aspect of information objects. Thirdly, librarians will increasingly find it difficult to describe digital objects, as the size of collections grow. For example, it would be prohibitively expensive for libraries to semantically describe the ever increasing amount of digital photographs that get generated and assembled at ever lower cost. Fourth, there are cultural differences in interpreting information objects. All these clearly demonstrate the need for devising new metadata approaches, and it is suggested a collaborative approach would be most appropriate.

Current metadata interoperability solutions

As pointed out earlier, the existence of several 'international' metadata standards, coupled with the proliferation of several "in-house" schemas, has exacerbated the problems of metadata interoperability. Under these circumstances, achieving metadata interoperability, with the adoption of a single standard,

becomes a daunting task (Haslhofer and Klas, 2010). In situations where several metadata standards co-exist, some of the approaches that have been employed to effect metadata interoperability include the use of metadata derivation, application profiles, metadata-cross walks (metadata matching), metadata registries and the use of semantic web technologies (Chan and Zeng, 2006; Day, 2003b; Nagamori and Sugimoto, 2006; NISO, 2004). However, it has been amply demonstrated that even the whole scale adoption of all these approaches and methods cannot provide the required semantic interoperability for effective cross-searching, content sharing, and information integration (Nilsson, 2010). Hence, metadata interoperability still remains a big challenge. Nevertheless, as having an overview of these approaches is deemed worthwhile, the following section deals with each briefly.

Metadata derivation. Amongst the above mentioned approaches, metadata derivation involves developing a new schema from an existing one (Chan and Zeng, 2006). Examples include MARC-XML, MARC-Lite, and Metadata Object Description Schema (MODS), all of which have been derived from the MARC standard. As MARC is widely viewed as being very cumbersome and complex, simpler schemas, considered easier and lighter for implementation, had to be developed (Chan and Zeng, 2006; Guenther and McCallum, 2003). For example, Day argues that "MARC formats may not be the best 'fit' for the dynamic and fugitive resources that inhabit the web environment" (Day, 2000). Guenther and McCallum (2003) note that the shift from the complex MARC format to a flexible and versatile XML encoding scheme is a timely and important adaptation.

Nevertheless, the principal problem with this approach is the fact that, as the problem of metadata interoperability is closely associated with each metadata element – depending on the way it is defined, labelled, represented, related to other elements, content values (controlled vocabularies), and constraints – making the schema lighter does not necessarily ensure semantic interoperability as there will always be a need to make sure that fields in the derived schema and their corresponding values (in the parent one) are properly understood by the end user.

Metadata application profiles. A second approach that has been employed to surmount interoperability difficulties is the use of application profiles (Chan and Zeng, 2006; Heery and Patel, 2000; Hillmann and Phipps, 2007; Baker et al., 2001). This is also known as a 'mix-and-match' solution, as it aims to bring together several elements from different schemas (Dekkers, 2002; Duval et al., 2002; Heery and Patel, 2000). The idea of developing and using application profiles seems to offer a promising remedy. However, the problem of metadata interoperability is rooted in the way that each metadata element and its associated values are semantically defined and used. Nevertheless, current application profile solutions fail to address these fundamental, underlying issues.

Furthermore, as pointed out by Haslhofer and Klas (2010), metadata has different levels of abstraction: meta-model, metadata schema and metadata instance – which has a bearing on interoperability. It is incontestable that application profiles enable the sharing of best metadata practises and permit re-use of metadata elements and, thus, help in avoiding unnecessary duplication of effort. However, they are a schema level solution. So while exposing metadata schemas constitutes part of the solution towards interoperability, it does not specify how metadata records (content values) are exchanged and used. As Nilsson (2010) argues, "the problem with defining meta-data application profiles using XML schema is that each application profile defines precisely which schemas you are allowed to use. Therefore, for each new meta-data vocabulary [that] you need to support, you will need to define a new application profile. This automatically puts a stop to the use of alternative meta-data descriptors, and results in an authoritarian limit on meta-data expressions." In this paper, it is argued that problems associated with "rigid" and "authoritarian" specifications should be properly addressed in order for such solutions to scale.

Metadata cross-walking (mapping). The third solution to interoperability difficulties is metadata cross walking (Chan and Zeng, 2006). A metadata cross walk "is a set of transformations applied to the content of elements in a source metadata standard that result in the storage of appropriately modified content in the analogous elements of a target metadata standard" (St. Pierre and LaPlant, 1998). For instance, a metadata cross-walk can be performed between Dublin Core and MARC and the common elements can be used to merge records of information objects defined using these two different schemas. For instance, as the element "245 $a" in MARC is equivalent to the "Title" element in Dublin Core, a metadata crosswalk could be employed to retrieve and seamlessly integrate records containing a particular value in either of the two fields or both. However, such equivalency mapping is very cumbersome and resource intensive. Moreover, by mapping a richer metadata schema to a simple one, such as from MARC to Dublin Core, the fields that do not have a corresponding counterpart are lost. Nilsson has amply demonstrated that metadata cross-walks/mappings are only helpful as short-term solutions to difficulties associated with making different standards interoperate seamlessly. Problems of cross-walking include disparities in terminology that can result in an incomplete mapping issues related to the maintenance of the mapping schema, lack of scalability as the number of constituent standards increases, and the problematic nature of mapping the semantics (Nilsson, 2010).

Metadata registries. A fourth approach to metadata interoperability issues is the use of metadata registries (Baker et al., 2001; Chan and Zeng, 2006; Day, 2003a; Dekkers, 2002; Heery et al., 2003). Metadata registries make various metadata specifications explicit, thereby enabling implementers to choose and pick elements from different sources when building applications that suit their purposes. The latter may lead to the development of application profiles (Bailer, 2007). Although this is an important service, a problem still remains unresolved in that these registries do not hold metadata content values. It is important to note that these particular metadata interoperability solutions do offer some level of interoperability at the schema level. However, at present, they do not deal with interoperability difficulties at the semantic (content) level.

Using XML for metadata interoperability. In contrast to the solutions suggested by Chan and Zeng (2006), Nagamori and Sugimoto (2006) and Zeng and Chan (2006), Nilsson (2010) maintains that current metadata interoperability techniques and methodologies, such as metadata cross-walks, application profiles and metadata registries, only play either a marginal role or are severely limited. One of the problems he identifies is the limitations of XML to provide semantic mark-up to metadata schema and content. Standards such as MODS, MARC-XML and METS use XML as their data encoding structure. However, as Decker et al. (2000) and Nilsson (2010) point out XML is ineffective for semantic interoperability. This is because XML "aims at document structure and imposes no common interpretation of the data contained in the document," (Decker et al., 2000) and, hence, does not embed semantics in its schema.

Semantic web technologies (RDF, RDFS, and OWL). In contrast to the solutions suggested above, Day (2000, 2003a, 2003b), Nilsson (2010), and Rothenberg (2008) argue that semantic interoperability can be achieved through the use of semantic web technologies such as Resource Description Framework (RDF), RDFS (RDF-Schema), and Web Ontology Language (OWL). It has been demonstrated that RDF's simple data model enables the creation of semantic links among information resources. An RDF schema adds vocabularies – such as Class, SubClass, Domain, and Range – to enable a more meaningful representation of resources. By extending RDFS with yet additional vocabularies, OWL allows the definition of additional semantic constructs such as equivalency, inverse and cardinality relations and constraints (W3C, 2004; Allemnag and Hendler, 2008). One of the defining features of the RDF model is its ability to identify resources and metadata attributes (relations) uniquely and globally using Uniform Resource Identifiers (URIs). The use of URIs for metadata element names, labels, and relations, according to Nilsson (Nilsson, 2010), helps to avoid naming and

identification conflicts in the use of elements. This is also suggested by Day (2000; 2003a; 2003b) and Rothenberg (2008). Unfortunately, although there happen to be several academic papers and technical specifications regarding RDF, RDFS, SPRQL (SPARQL Protocol and RDF Query Language), and OWL, there are no viable semantic web related metadata solutions in widespread use up until now.

The problems of metadata simplicity

One of the assumptions made in this paper is that the number of metadata elements (fields) constituting a standard has a direct bearing on metadata richness, which in turn directly contributes to seamless semantic interoperability. On the other hand, employing a metadata schema that has only a small number of elements, such as Dublin Core, increases syntactic interoperability. Incidentally, this has been clearly demonstrated in the case of the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) (Lagoze and Van de Sompel, 2007; Arms et al., 2002). This protocol provides archives with a mechanism for exposing their metadata to a metadata aggregator service and harvester, which in turn enables users to cross-search across information repositories (Lagoze and Van de Sompel, 2007).

Dublin Core was designed as a simple metadata schema for resource discovery (Lagoze, 2001a). At present, it is the most widely cited metadata standard. NISO (2004) seems to have endorsed its use in libraries, by stating that "because of its simplicity, the Dublin Core element set is now used by many outside the library community – researchers, museum curators, and music collectors to name only a few." This is quite a significant leap – from being "a metadata pidgin for digital tourists who must find their way in this linguistically diverse landscape" (Baker, 2000) to becoming a full-fledge metadata standard in use in libraries. However, Lagoze (2001b) strongly discourages the standard's use for richer metadata descriptions in libraries. As Lagoze (2010) points out, "reality is chaotic. It consists of entities and objects of all types and forms. These entities change over time and sometimes morph into other distinct objects. As a result entities are interrelated in numerous and complex ways." Hence, he argues, attempting to employ just 15 flat metadata elements to fully describe information resources is a futile effort. Furthermore, he also warns that extending the model, by incorporating more fields, would be of no help in enriching the results. Nevertheless, the Dublin Core Metadata Initiative (DCMI) has extended and qualified the 15 Dublin Core elements with additional elements, with the objective of using it for documenting richer descriptions of complex objects.

It is evident that the richer an object is described with metadata, the more likely that it conforms to the multitude of perspectives and interpretations of various groups of potential users. It is somewhat misleading to assume that metadata simplicity can be expressed in terms of the presence of just a few number of metadata elements. Moreover, interface simplicity is often confounded with metadata simplicity. For instance, Google is considered by many of its users as being very simple to use, to the point whereby almost every computer literate individual can type some keywords, hit the search button and retrieve results, if any. However, from the data simplicity perspective, the company owns a huge amount of both explicit and implicit metadata along with a large corpus of document collections, complex computer algorithms, and several web crawlers. In short, Google's metadata is rich and its interface is simple. In November 2005, the editor of Fast Company Magazine, Linda Tischler, remarked that "It is innovation's biggest paradox: We demand more and more from the stuff in our lives – more features, more function, more power – and yet we also increasingly demand that it be easy to use. And, in an Escher-like twist, the technology that's simplest to use is also, often, the most difficult to create" (Tischler, 2005).

Simplicity is a usability issue. However, metadata richness is of immense semantic concern and is more intimately related to the content than the interface. So any attempt to simplifying metadata – through either employing fewer metadata fields, mapping rich metadata sets to those with few fields (e.g., from

MARC to Dublin Core), and deriving light schemas from complex ones (i.e. metadata derivation) – is a misplaced objective as far as semantic interoperability is concerned. It is worth remembering that what is referred to as metadata complexity is a technical limitation, not a semantic one – although such a technical complexity inevitably affects semantic interoperability.

Along these lines, the question of providing an alternative spelling suggestion may not be technically complex for implementation in the OPAC interface. Instead, the way the OPAC and Google search systems behave differently seems to be closely related to differences in the underlying theoretical and philosophical assumptions that have been made by the developers and implementers of these two systems. It appears that Google reflects the reality of ordinary users' world, where it is common to make typographical errors. On the other hand, the OPAC interface reflects what is considered to be ontologically true, whereby metadata is 'quality assured' and users are expected to enter their terminologies in accordance with the expectation of the library personnel, who own the thesauri, taxonomy or classification system on which the indexes are based. Libraries focus on the quality and precision of search results whereas Google focuses on attracting more users towards its services. The effect is that users seem to be drawn to simpler, more flexible, instantaneous and down-to-earth services. The easier they get such features, the more attracted they become and the more time they spend on such services. As Tischler remarks, people demand simplicity, which is ease of use and something that works for them (Tischler, 2005). In his book, "the Laws of Simplicity", Maeda (2006), states that "simplicity is about subtracting the obvious, and adding the meaningful." He writes "more appears like less by simply moving it far, far away. Thus an experience is made simpler by keeping the result local, and moving the actual work to a far away location."

In regard to this idea of simplicity, a distinction should be made between what is presented to the user as metadata and what goes behind the scenes to semantically enriching information objects. Sadly, at present, the notion of metadata simplicity is taking a wrong connotation. Reducing the number of metadata elements robs information objects of their descriptive, contextual, provenance, technical and administrative information associated with these objects. To put it differently, metadata complexity is a good thing and it is only necessary that the interface (such as the library website and OPAC) be made simple and easy to use while maximizing its richness and functionality. On the other hand, as semantic interoperability inherently incorporates linguistic and cultural aspects, any attempt to resolve it, by using technical solutions alone (e.g., metadata cross-mapping) is bound to be a futile effort.

Metadata approaches

In what follows, the three broad approaches to the creation and management of metadata are discussed.

Standards-based metadata approaches. The role of information standards for cultural heritage institutions is a widely recognised one. Gill and Miller (2002) acknowledge the importance of standards in fostering consistency in digital libraries which in turn eases the exchange of cultural collections. Information standards take many forms: text and character encoding schemes, mark-up languages, metadata schemas, controlled vocabularies, and data transfer protocols. Character encoding schemes such as Unicode provide the underlying protocol to ensure most of the world's languages and their alphabets and special characters are represented in bit streams for use by machines. Mark-up such as SGML, HTML, and XML help encode fragments of documents for easy transfer and representation. Metadata schemas help to describe and annotate information resources. Internet protocols provide the physical transportation of bit streams from host to client computers.

In order for standards to achieve their intended purposes, it requires necessary ingredients such as significant international good will, interest, and investment in people, time, and technology by the developing agencies and implementing institutions (Mason, 2007). Gill and Miller (2002) argue "the

consistency that gives rise to interoperability in digital cultural collections is achieved through the use of standards – codified rules and guidelines for the creation, description and management of digital resources". Such consistency, however, cannot be achieved easily as the needs and demands vary across individuals, institutions, nations and regions. Even if the need for standards is apparent in several domains including digital libraries, it is important to note that there are a host of problems to implement them. One such problem has arisen as a result of the existence of several standards to do a similar function. In the area of metadata alone, there is significant number of standards. As Caplan (2000) indicates in reality institutions may prefer to use their own local schemas than adopting international standards for several reasons including politics, competition, institutional need to innovate and experiment. As a result, institutions use either local standards or a diverse mix of standards. This leaves the area of digital libraries in having several standards. There are hundreds of metadata schemes currently in use and each has its iterations (Greenberg, 2005). As a result, in the circle of cultural institutions, it is not uncommon to hear the adage "the best thing about standards is that there are so many to choose from" (Gill and Miller, 2002).

The irony is that standards themselves are in need of standards to make them talk each other. As Caplan (2000) observed "standards development is particularly difficult within the digital library arena, primarily because the most active players have not yet formed a true community in the sense of having evolved a common vocabulary, commonality of interest, or structures for collaboration and communication." In the choice of specific metadata standards for a particular collection, a NISO principle states the importance of analysing the appropriateness of the standard. In some instances the use of multiple standards as application profiles is also recommended based on the nature of the collection at hand (NISO, 2008).

However, there is a fundamental question that needs to be answered before choosing a specific set of metadata standards to a problem. That is, whether existing metadata standards themselves are adequate reflections of users' needs and expectations. This should be looked at in the context of whether current standards respond to semantic interoperability requirements from users. One way of looking at the viability of standards to users' needs is how standards are devised, developed and maintained. Another way to look at this is to ask users of standards how they think about them. Answering these questions would help to re-focus from asking "which standard fits best users' needs?" to "whether standards are required in the first place?"

Present metadata standards take the assumption that authors create works, librarians create metadata and users' access information objects. As Shirky (2005) argues, the art of classifying and categorising objects in the digital world is a forced limitation imposed from the habits of organising physical objects in the physical world. Thus, classification systems such as taxonomies, ontologies and categorisation systems such as Dewey Decimal Classification (DDC), and Library of Congress classification are severely limited to help us organise and find things in the digital world. The following diagram shows the traditional and still exiting library metadata (cataloguing) model.

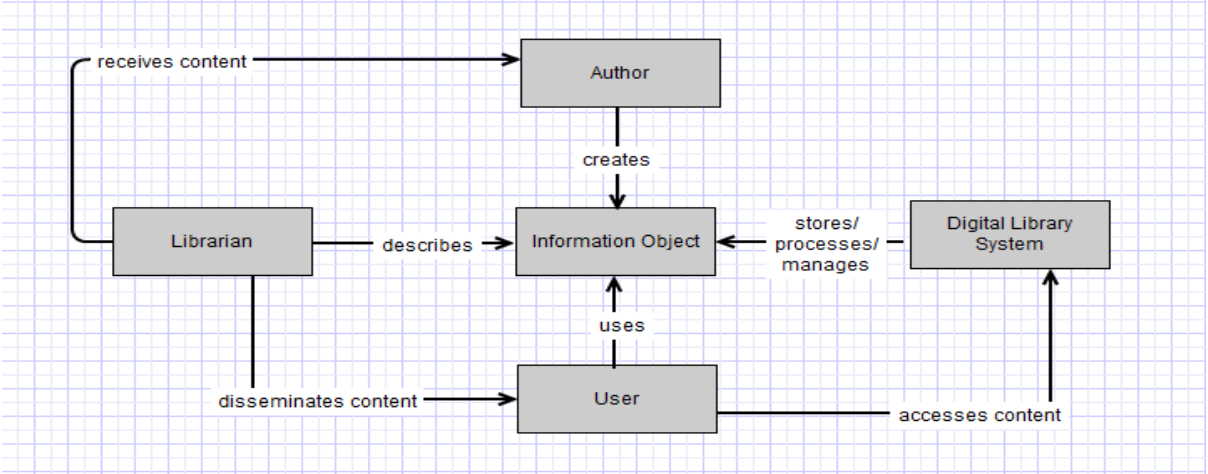

Figure 1: Authoritative metadata approach

However, as indicated in the next section, the boundaries between content creation, metadata creation and access to content has become very fluid.

Collaborative metadata approaches. The digital world, Shirky (2005) argues, is a radical break as a single object can be categorised and placed at an infinite number of places using hyperlinks. Shirky's argument about the inherited limitation of categorisation from the physical world is also echoed by David Weinberger (2007), in his book entitled "Everything is Miscellaneous". Weinberger writes about what he calls the first order of things where because of physical limitations an object must be placed in only one single location, example a book on a library shelf. Weinberger, however, contends that such constraint of the physical should not be casted into the digital. Both Shirky and Weinberger dispute the need to cleave digital information at the joints. Traditional systems including Aristotle's taxonomy and Dewey's decimal classification scheme were meant, Weinberger argues, for the physical world of things. This is to mean, while the traditional taxonomic categorisation of knowledge and the way such systems are developed has its place in the physical world such as library shelves (Dewey's classification system being, for instance, the most widely used system in public and university libraries across the world), it does not necessarily work for digital libraries. In the digital world, both owners and users of information can create their own categories and metadata in countless ways hence easing the discovery of digital objects. Amazon is an example of such faceted organisation of information (Weinberger, 2007).

Invoking the widely used definition of ontology, which is "an explicit specification of a conceptualization" (Gruber, 2007), Shirky disputes the assumption to arrive at an explicit formal specification of concepts (things) and argues "the idea of a perfect scheme is simply a Platonic ideal." According to Shirky (2005), ontological classification fails to work when libraries deal with large collection of objects (documents) and unstable entities (example East Germany, Soviet Union became unstable entities), and a lot of entities can be categorised into various branches in the taxonomic hierarchy. In addition, in devising taxonomies, the knowledge of users about the branches in the taxonomy is assumed in advance and as Shirky indicates this practice amounts to mind-reading and fails to take into account the diversity in perspectives. As Shirky (2005) points out "users have a terrifically hard time guessing how something they want will have been categorized in advance, unless they have been educated about those categories in advance as well, and the bigger the user base, the more work that user education is."

Involving users in the creation of metadata provides a richer metadata environment where diverse views are also reflected. In a collaborative approach (as shown in Fig.2), where machine, author, librarian, and

user generated metadata is harnessed, it provides a metadata ecology where user generated metadata is larger in size than the other types due to the fact that many users will get to contribute to the system.

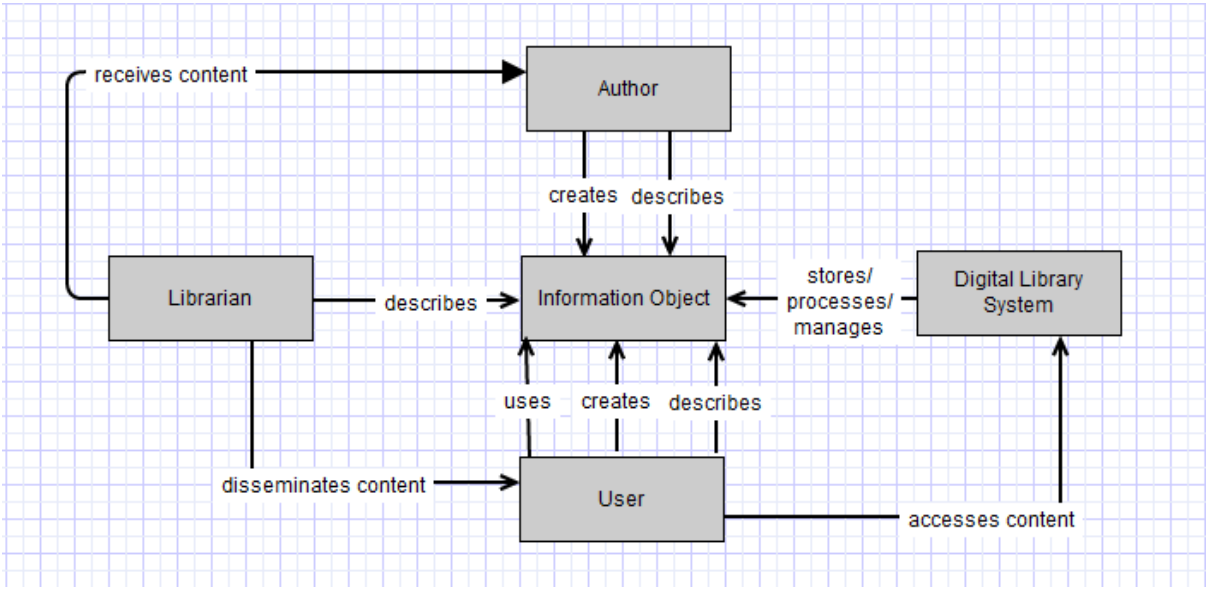

Figure 2: Collaborative metadata approach

The mixed metadata approach. In his book, Glut, Alex Wright (2007) asserts that networks (collaborative) and hierarchies (authoritative) categorisation systems are deeply embedded within society and culture and are not in opposition. He writes that social networks manifest themselves in the lives of many traditional societies (such as the native American Zunis and Australian Aborigines) (Wright, 2007). Chief among the examples in scientific classification systems, Wright explains, include Dmitri Mendeleev's tabular classification of periodic table of elements, and Carl Linnaeus' taxonomy of plants and animals (Weinberger, 2007; Wright, 2007). Taking us back to many thousands of years, Wright (2007) chronicles how information management takes shape: from tribal information dissemination systems, folk taxonomies, and mythological systems to the age of alphabets to collections of Sumerian temple libraries and to the Library of Alexandria in Egypt in the 3rd millennium B.C. As Wright points out, in both literate and pre-literate societies we could observe such preponderance to classifying living and non-living things. Questions such as whether this is innate to us, evolutionary or acquired through learning are discussed elsewhere in the literature. For instance, discussing about plant taxonomy, Stuessy (2008) contends that the "human species has a compulsion to order". This compulsion, Stuessy and Wright argue is both innate and learned. Stuessy asserts that beginning from childhood humans learn to sort things incrementally which helps them to avoid uncertainty. Both Stuessy and Wright also argue that much of the modern classification systems have their historical bases from traditional classification systems. Many of these early classification systems are mainly hierarchical (Stuessy, 2008). In short, Wright (2007) argues that today's Internet has brought back an earlier oral culture where "human beings interacted in small, tightly woven communities: families, villages, guilds, and other social groups whose members were bound by ties of direct kinship or close personal affiliation" which slowly evolve into institutional and hierarchical.

From a technological view point, Gruber (2007) argues that both hierarchical categorisation systems such as DDC and collaborative systems such as tagging have limitations where taxonomies are centrally controlled and categories are forced upon its users and so are folksonomies which are one-dimensional, plagued with inconsistency and lack of organisation (Gruber, 2007). Each has its advantages and disadvantages. Most importantly, Gruber argues that the two systems are not in opposition and comparing them, Gruber argues, is like comparing apples and oranges. So for Gruber the two

approaches can be harnessed through mashing-up of folksonomies and ontologies. Gruber suggests that the solution is to develop ontology for folksonomies which conceptualises the tags, the things tagged, and the tagger. While not in the context of creating ontologies, this paper takes the view that these authoritative and collaborative approaches can be harnessed in consideration of user interests. Fundamental to this is the need to think of a metadata ecology where the computer, librarians and users creating metadata which results in richer metadata environment continually informing one another and enriching users experience of the digital library.

Conclusions

There is no lack of metadata standards. However, the main challenge in today's digital libraries is for institutions to provide seamless access to information resources and for the users to make sense of the information they have accessed. The current interoperability solutions such as metadata-mapping, metadata registries and application profiles focus solely at a syntactic level, hence failing to address the semantics aspect of the problem. It is also argued that present metadata approaches are mainly authoritative and the actual users are not involved. Therefore, rather than trying to force interoperability solutions around a single standard, fostering an approach that promotes and encourages diversity seems prudent, as the latter approach is more attuned to human nature and the operations of its institutions.

Cultural artefacts very often lend themselves to various interpretations and contexts. As a result, most are described in varying metadata schemas, which in turn are developed at local, national, regional and international levels. Respecting and accommodating such differences, while pursing semantic consistency through a diversified approach would accrue meaningful results in the endeavour to achieve semantic interoperability. This paper focuses on solutions that respect diversity for a simple reason that a single solution or meaning cannot be enforced amidst cultural differences. It is argued that semantic interoperability does not, in any way, imply a singular understanding of a phenomenon. Instead it is mainly about allowing divergent groups to understand the intentions of each other when assigning meaning to a specific information object. Due to the very nature of the diversity inherent in institutional and cultural interpretations as well as differences in the usage of terms in metadata vocabularies, semantic metadata interoperability issues can better be addressed by adopting a social constructivist philosophical approach.

Practices in implementing library standards such as MARC seem to imply an objectivist philosophical perspective, whereas in reality, libraries and the interpretation of their information objects (metadata) tends to be disparate, perhaps suggesting the need for an interpretive perspective. The design and deployment of OPAC seem to favour an objectivist perspective, whilst the proliferation of Web 2.0 applications, such as social tagging (collaborative metadata), seems to follow a social constructivist philosophical perspective. Thus, the philosophical assumptions that underline the decisions of metadata standards setting agencies can significantly affect interoperability approaches and solutions. What is evident in the design and structure of present day metadata approaches is the lack of a theory that substantiates any one of the solutions. As metadata constitutes a central part of digital libraries, it is of paramount importance that the choice of metadata approaches is underpinned by a theoretical framework. Considering the disparity in the nature of digital libraries, their collections and the varying user needs, a social constructivist philosophical approach should be adopted to address the issues of semantic metadata interoperability.

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About the authors

Getaneh Alemu is a PhD student in School of Creative Technologies, and Dr Brett Stevens (Principal Lecturer, School of Creative Technologies) and Dr Penny Ross (Senior Lecturer, School of Computing) are both his supervisors, at the University of Portsmouth, Portsmouth, UK. Corresponding author for this paper can be contacted at Getaneh.Alemu@port.ac.uk