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The local in the global: universal bibliographic control from the bottom up

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Abstract:

The paper discusses the application of universal bibliographic control (UBC) in the environment of the Semantic Web and linked data. Attempts to implement UBC as a worldwide system for the control and exchange of bibliographic information using top-down methodologies have only partially succeeded at global scale. These attempts have included monolithic standard approaches for specific areas of bibliographic control such as metadata encoding using UNIMARC, content creation using ISBD, and identification of authority headings in GARR and FRAD. The abandoning of the last of these initiatives was partly influenced by the emerging technologies of the Semantic Web, specifically to link and re-use data from heterogeneous sources and allowing local approaches to be merged into ever larger communities of common practice to global level. The paper describes some of these new techniques which allow local metadata to be shared with non-local applications, and global metadata to be used in local applications. The paper discusses issues raised by these methods for bibliographic control. The fundamental difference in approach, within a linked data environment, is the refinement of a global set of description and relationship element to meet the needs of local applications versus the aggregation of existing local elements and subsequent emergence of global common points of view from local practice. The paper uses real examples from IFLA and non-IFLA standards such as RDA, Dublin Core, BIBFRAME and schema.org. The paper concludes that the vision of UBC developed over many years by IFLA remains valid and does not need to go into terminal decline, but a basic shift in point of view to the local from the global is required if the future is to benefit from the investments of the past.

Keywords: UBC, linked data, Semantic Web, localization, interoperability.

1 INTRODUCTION AND BACKGROUND

UBC: Universal bibliographic control programme, "the ultimate expression of IFLA's newly discovered maturity", as the then IFLA President Herman Liebaers wrote in the introduction to the IFLA document *Universal Bibliographic Control: A long term policy – A plan for action* published in 1974, has enabled the bibliographic services we have and use today. The document emphasises the responsibility of national bibliographic agencies for creating an authoritative bibliographic record of publications of their own countries and making them available to other bibliographic agencies. The process is carried out only by following international standards both in the creation of bibliographic as well as authority records (Anderson, 1974).

In fulfilling the aim of this programme, IFLA has, since 1961, taken over the responsibility and duty to develop and promote international standards, guidelines, rules and terminologies and, from the late 1990s, conceptual models. The main concept underpinning UBC was the idea of "uniformity": the choice of *uniform heading* for the name or title should be based on the "most frequently used name or the title appearing in editions of the works catalogued", thus ensuring that the same form of name would be present in all catalogues and making it both economical and efficient for libraries exchanging the records, and for users consulting different catalogues (Paris Principles, 1961). For example, ISBD: international standard bibliographic description was designed with the same concept (IMCE, 1969).

Dorothy Anderson, the first officer of the UBC Programme and the author of the UBC document cited, voiced quite clearly the dissent of some librarians regarding the "impossibility" of the concept of uniformity. She responded that the vision of the UBC system "is uniformity based on international standards, which may not always be embodied in a set of rigid rules, but are rather internationally accepted principles for particular problems which may permit national variations" (Anderson, 1974, 29-30).

The resulting framework for UBC mixed global and local approaches in an attempt to balance the self-descriptive derivation of uniform headings with the need to differentiate them at various levels of collection aggregation as well as within scope boundaries. It is obvious that differentiation is most required at the highest level, the collection of the world's entire bibliographic and cultural heritage "editions", yet equally the methods for achieving distinctive headings vary at more local levels. This indicated a need to separate the framework from the methodologies accommodated within it. Differentiation at global scale requires a global identity infrastructure; self-description is a transcription process applied at the most local level, that of the item in hand; collocation using headings lies somewhere in between.

2 ISSUES WITH A TOP-DOWN APPROACH

Global identity management needs a scheme for global identifiers. This requirement is managed at the levels of ISO standards for numbering systems such as ISBN, ISSN, ISRN, ISRC, and recently ISNI: the International Standard Name Identifier. Such identifiers are an integral part of bibliographic description in providing a necessary link from a particular (local) description to a global numbering system that can provide unique identification.

However, labelling conventions in the form of authorized access points that together with variant forms make controlled access points require intellectual effort in matching them to the same entity. That is, the concept of authorized access point that has replaced that of the uniform heading prefers the "national user" and her needs, and consequently the form of the preferred access point has become dependent on the particular bibliographic agency using particular cataloguing rules. It is no longer a view of "culturally respecting the other", but now a rule that "this is my cultural view of the other, as least that is how I understand it". The explanation of such a change of view within the UBC concept is that the same form of heading used globally for an entity is "not practical and […] no longer necessary, [because] with computer capabilities developing more sophistication, we can link the authority records created in one country according to one set of cataloguing rules with those in another country to facilitate sharing authority records and potentially to enable computer-assisted switching to display authorized forms" (GARR, 2001, ix).

The first union authority file was the CERL Thesaurus, the authority file for the Hand Press Book database (now, The Heritage of the Printed Book in Europe, c. 1455 - c. 1830) developed by the Consortium of European Research Libraries in the late 1990s. The CERL Thesaurus "merges standard and authority forms of names that are used in present day library catalogues without imposing CERL's own authoritative form of name. Instead, standard and variant forms are listed alphabetically with a clear indication of the institutions that use a particular standard form" (CERL Thesaurus). Differences in cataloguing practices of retro-converted card catalogues or even inventory lists prevented the possibility of even aiming at the target of a uniform heading/access point for the entities described, including places, printers, authors etc. For example, there are 41 forms of name for Lyon as a place of printing (Permalink http://thesaurus.cerl.org/record/cnl00011383). It must be noted, though, that intellectual effort was involved in the matching of names, and not just computer algorithms.

Thus backwards compatibility to reduce data conversion and system development costs was the main reason for deciding to design a thesaurus, rather than an authority file with the uniform heading concept. Such a view can easily prevail today, with major changes envisaged in adopting or developing new cataloguing rules: the "uniform" heading concept constrains future content to fit legacy content.

VIAF: Virtual International Authority File is a similar type of union authority file, although with some different functionality (VIAF, 2014). The intention is not quite the same: it is to link different forms of authorized access points defined by different national bibliographic agencies for the same identity. Variant forms of the names are not taken into account. The same query for Lyon (Permalink http://viaf.org/viaf/158189703) shows only the authorized place name as used by eight national libraries.

There is, however, no clear method for change management or retro-conversion within a single bibliographic database or a union catalogue. For example, one of the major problems likely to be caused by the implementation of the ISBD consolidated edition is the new *0 Content form and media type area* which has been introduced to replace the *GMD: general material designation* element of the specialized ISBDs. The issue is about what to do with the legacy element 1.2 that was consistently introduced in the ISBD stipulations and descriptive records, when the GMD concept is deprecated and the same enumeration is used for the ISBD *Parallel title* element in the consolidated edition. The UNIMARC bibliographic format has not yet declared obsolete this element *200 $b General Material Designation* (UNIMARC Bibliographic Format, Update 2012), and it can be expected to be present in legacy records.

How should we deal with something that was once considered important to the users of a catalogue, yet has been deprecated in the newer standard? Does this indicate that a standard element can lose its "international/global" context and become a local element still important enough to be retained?

3 LOCALIZATION AND GLOBALIZATION

The instruction "Think global, act local" is based on the work of Patrick Geddes in the field of town-planning: "… each valid scheme should and must embody the full utilisation of its local and regional conditions, and be the expression of local and regional personality. 'Local character' … is attained only in course of adequate grasp and treatment of the whole environment, and in active sympathy with the essential and characteristic life of the place concerned" (Geddes, 1915). In recent years it has been employed more generally in the context of environmental health, but it is useful to make it a dictum for cultural heritage linked data.

In the bibliographic and cultural heritage context, local data structures are required to accommodate local content for a local audience within a local culture. At the same time, each user may have goals that can only be met by non-local content covering foreign topics or located outside of the local boundary. This is a universal situation for every user: a need for a local view of everything, such as a national library collection that supports all subjects of interest to the inhabitants of its country, and for a global view of the local, such as a national library collection that supports subjects of national interest according to culture, language, and so on, found anywhere in the world. That is, a national library holds a copy of every book published within the nation, and a copy of many books about the nation published elsewhere. Local content is held in global carriers, and global content is held in local carriers.

"Local" and "global" are completely relative to one another, with "regional" lying in between. Therefore a fine-grained approach is needed to accommodate local variation in metadata schemas and also be consistent with global perspectives. This must be more granular than the bibliographic record. The record-level unit of current schema is too broad and inflexible: local applications may not require all data elements; local sources may not supply content for "mandatory" elements. The problem has been well-exposed in similar contexts, for example in the development of the National Science Digital Library (Hillmann, Dushay and Phipps, 2004) and of Europeana (EDM Primer, 2013). In both of these cases the solution was to shift the level of metadata granularity from the record to the individual statements contained in the record as name/tag-value pairs for attributes or fields.

4 LINKED DATA AND RDF

Resource Description Framework (RDF) is the data format of the global Semantic Web and linked data environment. It represents metadata in the form of single statements about an identified thing. Each statement is in three parts and is called a triple. The subject of the statement is given first, followed by the identified aspect of the thing being described, called a predicate or property, followed by the value or identifier of the aspect of the thing, called an object: a triple is a subject – property – object statement. Identifiers in RDF are Universal Resource Identifiers (URIs) which are unique at global, and therefore local, level. An example of a triple is ex:Resource1 isbd:P1016 "Zagreb". This uses terse triple language (ttl) format where the URIs are given in a compact form and literal values are enclosed in quotation marks. The compact URI *isbd:P1016* expands to the full URI http://iflastandards.info/ns/isbd/elements/P1016 which has the label "has place of publication, production, distribution" (ISBD Elements, 2014). The abbreviation "ex:" (for "example") stands in for any local namespace of resource URIs. The example triple therefore represents the statement:

"The thing identified by the compact URI ex:Resource1 has place of publication, production, distribution 'Zagreb'".

The structure of an RDF triple means that the granularity of the statement is governed by the property only; the granularity of any subject is fixed by definition and the object reflects the granularity of the property. For example, a finer-grained statement about the same subject is:

"The thing identified by the compact URI ex:Resource1 has place of publication 'Zagreb'"

This can be represented by the triple ex:Resource1 rdam:P30088 "Zagreb" using the RDA Manifestation property with the label "has place of publication" (RDA Registry, 2014).

An example of a coarser-grained triple is ex:Resource1 bf:provider "Zagreb : Hrvatsko knjižničarsko društvo, 2012" using the BIBFRAME property with the label "Place, name, and/or date information relating to the publication, printing, distribution, issue, release, or production instance" (BIBFRAME, 2014).

Triple	*Property label in English*	*Granularity*
ex:Resource1 rdam:P30088 "Zagreb"	RDA: has place of publication	Fine
ex:Resource1 isbd:P1016 "Zagreb"	ISBD: has place of publication, production, distribution	Medium
ex:Resource1 bf:provider "Zagreb : Hrvatsko knjižničarsko društvo, 2012"	BIBFRAME: Place, name, and/or date information relating to the publication, printing, distribution, issue, release, or production instance	Coarse

Table 1: Different levels of granularity in triple properties.

It should be noted that although Table 1 reflects a general categorization of the relative granularity between BIBFRAME, ISBD, and RDA, each namespace has finer or coarser properties of its own for the aspect of place of publication; for example RDA has the coarser "has publication statement", ISBD has the coarser "has publication, production, distribution, etc. area", and BIBFRAME has the finer "Place associated with the publication, printing, distribution, issue, release or production of the instance".

Table 1 also illustrates the two types of granularity that appear in bibliographic description: semantic, and syntactic. The sequence "place of publication" < "… place of publication, production, …" is an example of fine-to-coarse semantic granularity, from one kind of place to several kinds of place combined. The sequence "… place of publication …" < "place, name … relating to the publication … instance" is an example of fine-to-coarse syntactic granularity, from place alone to place combined with the name of the publisher. The coarser property also has a broader meaning but the semantic relationship has a combinatorial rather than hierarchical structure. These two types of granularity are reflected by the RDA categorization of elements into element, element sub-type, and sub-element (JSC, 2009).

Sharing and re-using data under UBC requires automated methods for moving data between different levels of granularity. Such methods can be envisaged as a set of "black boxes" which take triples as input and produce other triples as output, using internal software which processes the data in a consistent way. An important feature is that the box outputs new data triples but does not replace the input triples, which remain available for input into other processes.

Six examples of such boxes are suggested here: Schema Translator, Term Translator, Statement Maker, Statement Breaker, Record Maker, and Record Breaker.

Figure A: The Schema Translator black box.

In Figure A, the "Schema Translator" black box "translates" data created using the element set of one namespace into another namespace. A metadata statement created using one bibliographic schema is translated into a statement compatible with a related schema. In the example, a triple using the RDA manifestation property P30088 (has place of publication) is input, an output option for ISBD is selected, and the output is the ISBD property P1016 (has place of publication, production, distribution). The example is based on the alignments between ISBD and RDA elements, represented as an RDF map using RDF Schema sub-property relationships (Dunsire and ISBD Review Group, 2012). The relationship embeds a machine-actionable rule that creates a clone of the input triple with a predicate from the output element set.

It should be noted that this black box operates in one direction only. It "dumbs-down" the data to ensure the semantics of the output statement are consistent in the target schema. It is not possible to "smarten-up" a statement by deducing a more specific statement. For example, if a Schema Translator uses a suggested ontology of ISBD, RDA, and DC "title" elements (Dunsire, Hillmann, and Phipps, 2012, diagram 6) it will translate ISBD property P1004 (has title proper) to the Dublin Core property title (DCMI Usage Board, 2012):

Schema Translator (ex:Resource1 isbd:P1004 "Poem") = ex:Resource1 dc:title "Poem".

According to the ontology, the same output results from an input of data using RDA Manifestation properties such as P30156 (has title proper) so an inverse process would have to guess what output to make. Using the RDA property implies the subject URI identifies a *Manifestation*, whereas the ISBD property implies a *Resource*; they are not the same (Dunsire, 2013). If the Schema Translator output above is fed back in as input, the only possible output is an even coarser schema such as schema.org (schema.org, 2014):

Schema Translator (ex:Resource1 dc:title "Poem") = ex:Resource1 schema:name "Poem".

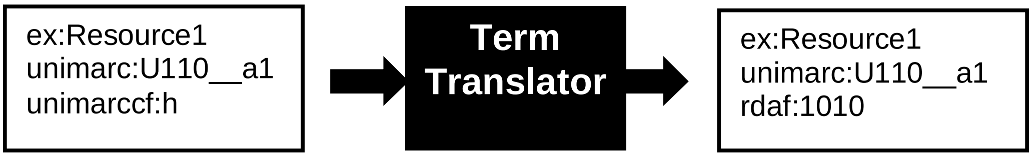

Figure B: The Term Translator black box.

The "Term Translator" black box in Figure B "translates" data values from one knowledge organization system (KOS) into another. A metadata statement which contains a value from a controlled terminology is translated into a statement with a value from another terminology. In the example, a triple using the UNIMARC Bibliographic property U110__1a (Frequency of issue in Continuing Resource Coded Data in Coded Data Field: Continuing Resources) with the object URI for the code "h" in the *unimarccf* (Continuing resources: Frequency of issue) controlled vocabulary is input, and an option for RDA is selected for output, the object URI for the similar value in the *rdaf* (RDA Frequency) vocabulary.

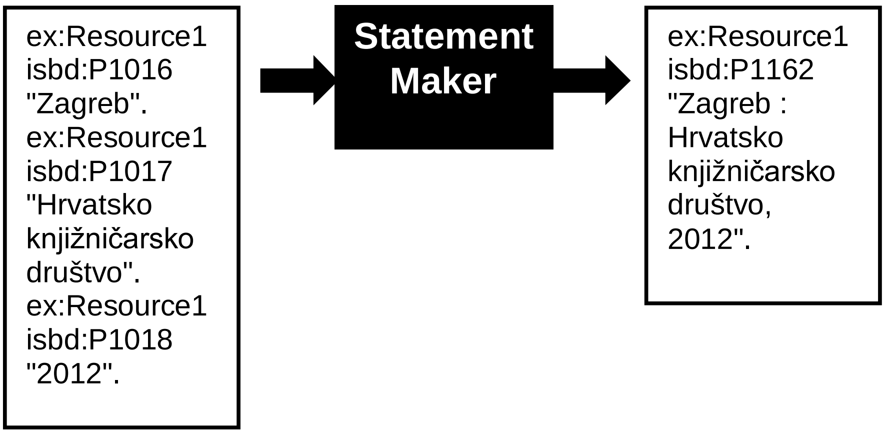

Figure C: The Statement Maker black box.

In Figure C, the "Statement Maker" black box concatenates the values of a set of fine-grained metadata statements into a coarser grained aggregated statement by adding delimiters such as punctuation or encoding for layout or display. In the example, triples using the ISBD properties isbd:P1016 (has place of publication, production, distribution), isbd:P1017 (has name of publisher, producer, distributor), and isbd:P1018 (has date of publication, production, distribution) are input, and the black box outputs the aggregated statement isbd:P1162 (has publication, production, distribution, etc. area) using ISBD punctuation rules (ISBD, 2011).

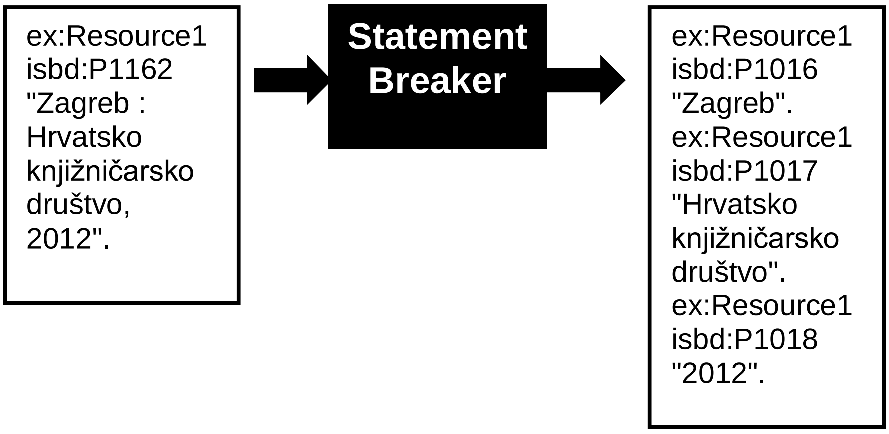

Figure D: The Statement Breaker black box.

The "Statement Breaker" black box in Figure D has the inverse function of the Statement Maker black box in Figure C. It parses the value of an aggregated metadata statement into a set of finer-grained statements by recognizing its delimiters before removing them. In the example, a triple using the aggregated statement property isbd:P1162 (has publication, production, distribution, etc. area) is input, and the black box outputs its component triples using the ISBD properties isbd:P1016 (has place of publication, production, distribution), isbd:P1017 (has name of publisher, producer, distributor), and isbd:P1018 (has date of publication, production, distribution) after removing the ISBD punctuation.

Figure E: The Record Maker black box.

The "Record Maker" black box in Figure E extends the functionality of the Statement Maker of Figure C. It uses an application profile to specify the components and structure of a metadata record according to a schema. An application profile defines metadata records which meet specific application needs by articulating what is intended and can be expected from data (Coyle and Baker, 2009). In the example, a set of triples using RDA properties, including aggregated statements, is input and an RDA "record" is output as a set of triples matching an application profile that specifies that only "core" properties are to be used, together with their order of presentation, and the mandatory and repeatability status of each.

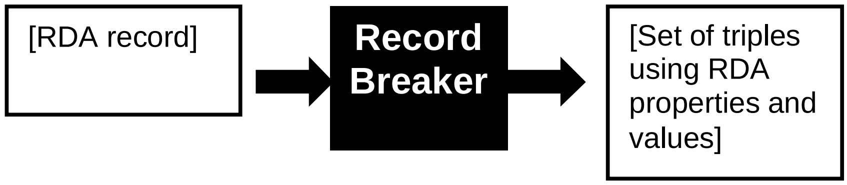

Figure F: The Record Breaker black box.

The "Record Breaker" black box in Figure F has the inverse function of the Record Maker box in Figure E. It parses a metadata record into its component elements using an application profile for the record schema. In the example, an RDA record encoded in a particular syntax is input and the black box outputs a set of triples using properties and values from the RDA namespace.

Different kinds of black box can be chained together to accommodate more complex interoperability functions. For example, linked data records for a particular resource discovery service can be produced by gathering metadata statements from a variety of sources using different elements and terminologies, and feeding them through a sequence of Schema Translator, Term Translator, Statement Maker, and Record Maker processes.

The internal processes required inside each kind of black box are well-understood in the Semantic Web communities, and there are no insurmountable technical barriers to developing such linked data processing software agents. They could become opaque components of semantic web browsers, like the automated language translator and time-zone converter plug-ins for standard browsers of the web of documents. However, for the boxes to work their developers need RDF representations of bibliographic standards, as well as the maps relating them and the application profiles for record-like sets of metadata statements.

5 HOW TO THINK GLOBALLY

It should be assumed that everything is connected to everything else at the global level, if not now, then in the future. The links between things will be duplicated, either directly or via multiple pathways through the Semantic Web. For example, a bibliographic resource might be linked to its place of publication directly, through a *place of publication* or *publication place* attribute, or indirectly via a *publication statement* , or via the *publisher's name* which itself is linked to the *publisher's location*. It is therefore sufficient to focus on one specific thing, or a type of thing, at a time. It is more efficient to create descriptive metadata for a resource and then link it to a place, or create metadata for the place and then link it to the resource, than it is to describe both resource and place in a single local operation. Other communities will take the same approach; for example, government information services will also create metadata for places as part of census data.

Local aspects of a thing can be treated as conceptual refinements of a global point of view. For example, the specific attribute *title proper* used in bibliographic description is a refinement of a more general attribute *title* used in the cultural heritage sector, such as the title of a painting. The attribute *title* is itself a refinement of the generic concept of *label*; all individual things can be labelled to provide a textual identifier. The *name* attribute of a person, family, or corporate body is also a refinement of *label*, and is refined in turn by *pseudonym* , an aspect of the bibliographic entity persona.

Special aspects confined to bibliographic entities may be added to the global set of attributes if necessary, when there is no existing general attribute to refine. This is a rare situation because aspects specific to a local community tend to be adapted for more general use if they cover a gap in the global view. For example, the attribute *edition* was originally applied to printed monographs, but is now used for "special editions" of moving pictures and even chocolate bars.

It is important to keep things separate; that is, avoid conflating the identities of what are different entities from a global point of view. For example, although the content is the same, a resource and its digital surrogate are better treated as distinct things rather than given the same identity (IME ICC, 2009). A digitized photograph is not a digital photograph, and the difference is significant in any schema which has separate entities for describing content and carrier characteristics, such as BIBFRAME's *Work* and *Instance*.

6 HOW TO ACT LOCALLY

The Semantic Web is based on the World-Wide Web, which is based in turn on the Internet. The linked data environment is therefore available to anyone with access to the Internet. The technical barriers are low for the publication of local metadata schemas and terminologies in RDF, allowing the publication of local bibliographic records as data triples without loss of detail. For example, triples can be created using common text editors. The infrastructure includes open access tools for publishing and managing element sets and value vocabularies, such as the Open Metadata Registry used for the IFLA and RDA namespaces (Open Metadata Registry, 2014). There is also a wide range of support documentation, from technical standards to social networking sites.

If local usage of a global schema is completely compliant, the elements of the schema namespace, if available, can be used to publish dataset triples without dumbing-down the source data. Re-use of global elements reduces unnecessary proliferation of element sets and value vocabularies with very close semantics and Schema Translators that are little more than an Identity Matcher (another required type of black box). However, if variation is significant to the local context, then dumb-down can be avoided if the variation is represented as a refinement of the global schema, or if a local schema is represented in its own namespace. Preserving the local state of the data allows the global environment to use it without prior censorship.

Local element sets and variants need to be related to global element sets by a map to be used by a Schema Translator from local to global schema. Local and global value vocabularies must also be aligned for an appropriate Term Translator.

If a local element set includes classes for local types of bibliographic entity, then it is useful to publish unconstrained versions of the properties, not bound to any entity, to support maps to global schema which are incompatible with the local entities. For example, the RDA namespace includes properties that are not constrained by the RDA/FRBR entities (*WEMI*), to allow maps to non-FRBR schema such as ISBD. Similarly, a version of the ISBD element set with no association with the entity *Resource* will be published to enable a full map from ISBD to RDA.

When a local linked data application uses global open datasets, value vocabularies, element sets, maps, application profiles, and so on, it will generally be better to link dynamically or use a local cache with a frequent refresh rate than to copy a static snapshot of the external data. The benefits of sharing data are best achieved if the data are kept in a common pool and not detached from the web of data, the "cloud" in current terminology. New global data is immediately available, and unnecessary local duplication can be minimised.

7 CONCLUSION

This paper assumes a near future in which the Semantic Web is becoming as commonplace, and invisible, as the web of documents currently accessed by smart phones and TVs, tablets, and laptops. What is being accessed is digital content, born or surrogate, and it requires "smart" bibliographic control to support services for resource discovery. The principles and framework are established and modernised; it is the methods that must change if the library and cultural heritage community is to benefit from, and contribute to, the linked data environment.

Smart UBC should strive to support all those who wish to think globally and act locally, with a better mix of bottom-up and top-down methodologies.

This is UBC from the bottom up, and our challenge to policy makers and managers:

- Match local identifiers to global identifiers, for example VIAF or ISNI.
- Publish local data and local schema as they are, directly into RDF.
- Manage maps between local elements and global elements.
- Provide the infrastructure to refine and extend global elements to suit local applications.
- Provide the infrastructure to feedback common local elements into global elements.

The black boxes are our challenge to developers. The authors and many colleagues in the IFLA and RDA communities have contributed to a "real soon now" Schema Translator for ISBD to RDA, so we think this is a fair challenge. And our experience tells us that out of this type of "exercise" we will find out what is lacking in the present bibliographic and cultural heritage standards.

There should be nothing strange about this; it follows from our human nature. After all, we all look at the same thing with differing individual and culture points of view, but otherwise similar *Homo sapiens* brains. Our descriptions of things must therefore be a mix of intrinsic and extrinsic observations. In the linked data environment, the semantics of the local is expressed in a global syntax; the semantics of the global is in the local.

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