Business Planning for Digital Libraries

International Approaches

Mel Collier (ed.)

LEUVEN UNIVERSITY PRESS

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About the authors

Ian **Anderson** is Senior Lecturer in New Technologies for the Humanities at the University of Glasgow, Scotland, and member of the Humanities Advanced Technology and Information Institute (HATII). He conducts research on web services for digital libraries, the archive and feminist theory, the interrelationships between identity, memory, writing and history, retention and deletion decision making in lay record managers and self-preserving digital objects.

Lluís **Anglada** is director of the Catalan Academic Library Consortium and was formerly the library director of the Catalonia Technical University and professor for three years in the School of Librarianship of Barcelona University. He is active in various professional associations at Catalan, Spanish and international levels, including the scientific committees of professional conferences in Catalonia and Spain, European meetings of ICOLC and Library Advisory Boards of Academic Press, Blackwell Publishing, Nature Publishing Group and Springer.

Ángel **Borrego** is a lecturer in the Department of Library and Information Science at the University of Barcelona, teaching an undergraduate course in information behaviour, and co-ordinating the School's doctoral programme. His current research interests focus on scholarly communication and information behaviour in the electronic environment.

Genevieve **Clavel-Merrin** is responsible for national and international cooperation at the Swiss National Library in Bern. She is currently working on projects covering digitization and its coordination in Swiss libraries, plus public-private partnerships. She is active in the field of multilingual access (MACS - Multilingual Access to Subjects) and IFLA. She has wide experience in European-funded projects and is the Swiss representative for The European Library.

Mel **Collier** is Chief Librarian at the University of Leuven and a consultant in the fields of change management and innovation in libraries and learning in institutions of higher education. For the last ten years he has worked on business planning for digital libraries, including The European Library and Europeana.

Núria **Comellas** is Project Manager at the Consortium of Academic Libraries of Catalonia responsible for negotiating and the licensing of electronic resources on behalf of the consortium library members and the division of costs between them. She was formerly a librarian at Universitat Oberta de Catalunya and at Universitat Politècnica de Catalunya.

Stefan **Gradmann** is Professor of Library and Information Science with a focus on knowledge management and semantics based operations at the Humboldt University of Berlin. He studied Greek, philosophy and German literature in Paris and Freiburg (Brsg.) and received his Ph.D in Freiburg in 1986 in Literary Studies. He has worked as scientific librarian at the State and University Library in Hamburg, he was the director of the GBV Library Network, and worked for Pica B.V. in Leiden as product manager and senior consultant. Later he was Deputy Director of the University of Hamburg Regional Computing Center, the Project Director of the GAP (German Academic Publishing)

Project of the German Research Association, and technical co-ordinator of the EC funded project FIGARO. He is currently heavily involved in building Europeana, the European Digital Library, specifically as co-leader of WP3 on technical and semantic interoperability and leader of EuropeanaConnect WP1 (Semantic Data Layer).

Rolf **Hapel** is director of Citizens' Services and Libraries in Aarhus, Denmark, and currently member of the coordination board for net libraries. He was awarded the order of Dannebrog and is an honorary professor at the Danish Library School. Aarhus Public Libraries received the Gates Foundation's "Access to Learning Award" 2004, was among the top ranked public institutions in Innovation Cup 2007 and is frequently top benchmarked in "Best on the Internet".

Kristiina **Hormia-Poutanen** is the Deputy National Librarian of the National Library of Finland and director of the Library Network Services department. She is a member of the LIBER board and chair of the LIBER Digitization and Resource Discovery section. She is the chair of the availability section of the Finnish Digital Library project. She is active in various national and international initiatives, including IFLA, ICOLC, LIBER and eIFL especially in relation to digital library infrastructures, consortia development issues, licensing and licensing models and open access.

Dirk **Kinnaes** is Project Manager with LIBIS, the ICT department of Leuven University Library, which also provides ICT services to a large number of external library and archive clients through LIBISnet. He is a key participant in the development and implementation of LIAS, the Leuven Integrated Archive System.

Paul **Koerbin** is the Manager of Web Archiving at the National Library of Australia with responsibilities for the PANDORA Archive and the Library's web domain harvesting programme.

Derek **Law** was Head of the Information Resources Directorate and University Librarian of Strathclyde University, Glasgow from 1999 until October 2008. He holds a chair in the Department of Computing and Information Science and is a member of the Centre for Digital Library Research. He has written extensively on the development of digital libraries, on the role of information in e-learning, on digital information systems and has a subsidiary interest in naval history.

Gary S. **Lawrence** retired from the position of Director of Systemwide Library Planning for the University of California system in June 2008.

Chern Li **Liew** is a Senior Lecturer in the School of Information Management at Victoria University of Wellington. She holds a PhD in Information Studies from Nanyang Technological University (Singapore), and an MSc from Loughborough University. She has published in the areas of digital libraries, digital cultural heritage, user studies and knowledge organization.

Angelika **Menne-Haritz** is Director of the 'Archives of Parties and Mass Organisations of the former GDR' foundation in the Federal Archives in Berlin. She has extensive experience as an archival educator and teacher in administrative sciences. She received a PhD in literature and history, then undertook her archival training at the Archivschule Marburg and worked in the state archives of Berlin and of Schleswig-Holstein, before becoming director of the Archivschule Marburg. She passed her qualification for professorship (habilitation) at the German University of Administrative Sciences Speyer with a thesis on 'Business Processes'.

Paula **Mikkonen** is a licensing coordinator at the FinELib Consortium service unit of the Library Network Services department of the National Library of Finland. The service unit negotiates licence agreements of e-resources for the use of the FinELib Consortium member organizations.

Marc **Nelissen** is an Archivist in the University Archive and Art Patrimonium department of Leuven University Library. He is a key participant in the development and implementation of LIAS, the Leuven Integrated Archive System.

Michael **Popham** is Head of Oxford Digital Library, a core service of Oxford University. He is also the director of Electronic Ephemera, a project funded by JISC to digitize selections from the John Johnson collection.

David C. **Prosser** was appointed the founding Director of SPARC Europe in 2002, following a career as a scholarly publisher for Elsevier Science and Oxford University Press. In December 2009 it was announced that he has been appointed as Executive Director of Research Libraries UK, a consortium of 29 of the largest research organizations in the UK, including the three national libraries.

Wouter **Schallier** is since 2008 the Executive Director of LIBER (Association of European Research Libraries), based in The Hague, Netherlands. He was the Librarian of the Biomedical Library of Leuven University from 2005 until 2008.

Luc **Schokkaert** is Head of Public Services and IT at KADOC, the documentation and research centre for religion, culture and society, based at Leuven University. He is a key participant in the development and implementation of LIAS, the Leuven Integrated Archive System.

Barbara **Sierman** is Digital Preservation Manager at the Koninklijke Bibliotheek, the national library of the Netherlands in The Hague. She started her career at Pica (now OCLC) as a library consultant and, after various jobs in IT, she joined the KB in 2005.

Alma **Swan** is the joint proprietor of Key Perspectives Ltd., founded in 1996. After research at Southampton University and a lectureship at Leicester University she became managing editor of an Elsevier Science biomedical research indexing service. She is a Visiting Researcher in the School of Electronics & Computer Science at the University of Southampton, Associate Fellow in the Marketing and Strategic Management Group at Warwick Business School and editor of The Euroscientist.

Hilde **Van Kiel** is Head of the central University Library Services of the University Library of Leuven and coordinator of e-resources. She obtained a master's degree in history from K.U.Leuven and previously worked as a librarian and network administrator for KPMG Tiberghien & Co.

Harry **Verwayen** is Business Development Director at Europeana in The Hague and formerly worked at the think-tank Knowledgeland in Amsterdam. His specializes on business model innovation in the public sector, the use of visual thinking in problem solving and innovation in the cultural heritage sector.

Hazel **Woodward** has been University Librarian and Director of the University Press at Cranfield University (UK) for over nine years. Her research interests include electronic publishing and scholarly communication (the subject of her PhD thesis) and she has published many papers in the professional literature on digital library issues. She is very active professionally, being currently the Chair of the JISC E-Books Working Group and a member of the JISC Journal Working Group.

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DIGITAL LIBRARY METADATA

Stefan Gradmann

Introduction

The simplest and broadest definition of metadata states that they are “data about data”. In this sense, metadata can refer to almost anything in the world provided the referenced item can be conceived as ‘data’.

A more specific and helpful definition focusing on Digital Libraries is that metadata are structured sets of statements on digital information objects which enable users to identify, retrieve, manage and use such information objects.

The statements made in metadata can *pertain to different characteristics* of the information objects held in Digital Libraries (they may for instance refer to semantic, technical or administrative aspects) and may *vary in granularity* (between extremes such as the 15 attributes of the Dublin Core Metadata Set (DC) and the hundreds of fields and sub-fields of MARC21). And, finally, metadata can be *part of the information objects* or *stored separately* and then include a link to the objects they refer to.

State of the art

Types of metadata

As in a recent JISC Technology and Standards Watch report (Gartner 2008) the following categories of metadata can be distinguished with respect to the object characteristics they refer to:

- descriptive metadata: these are similar to the traditional catalogue record and contain statements on semantic aspects of the objects enabling retrieval and intellectual assessment (for differences between descriptive metadata and catalogue records one could refer to Gradmann (1998))
- administrative metadata: the information necessary to curate the object, including as sub-categories
 - technical metadata: all technical information (e.g. file format or file size) necessary to store and process the object
 - rights management: declarations of rights held in the object and the information necessary to restrict its delivery to those entitled to access it
 - digital provenance: information on the creation and subsequent treatment of the digital object, including details of relevant actors for each event in its lifespan

- structural metadata: information representing the internal structure of an item so that it can be rendered to the user in a sensible form as well as effectively quoted, enabling external references to its microstructure elements.

Additionally, object identifiers should be included here, since they can be considered as a specific meta-statement pertaining to a given object: instead of relating to any particular property they pertain to the object as a whole and imply a statement on its identity.

Examples of descriptive metadata frameworks include Dublin Core (<http://dublincore.org/>) and MODS (Metadata Object Description Schema, <http://www.loc.gov/standards/mods/>) - the former being an extremely simplified set of just 15 attributes like *creator* or *rights*, whereas the latter is derived from the rich MARC format and provides a more granular set of approximately 80 attributes.

Technical metadata examples include such complex standards as TEI (Text Encoding Initiative, <http://www.tei-c.org/>) or DocBook (<http://www.docbook.org/>) for textual objects, Metadata for Images in XML (MIX, <http://www.loc.gov/standards/mix/>) for still images, MPEG 7 (<http://www.chiariglione.org/mpeg/>) for audio objects or MP4 for video. Statements on rights can be expressed using standards such as the XrML (eXtensible Rights Markup Language, <http://www.xrml.org/>), the Open Digital Rights Language (ODRL, <http://odrl.net/>) or again Online Information eXchange (ONIX, <http://www.editeur.org/8/ONIX/>). Digital provenance statements can be based on rich standards such as PREMIS (PREservation Metadata Implementation Strategies, <http://www.oclc.org/research/projects/pmwg/>) and structural metadata include, once again, TEI based statements, but also emerging standards such as Resource Maps as defined by OAI-ORE (Object Reuse and Exchange, <http://www.openarchives.org/ore/>). Finally, object identifier frameworks include examples such as the Digital Object Identifier (DOI, <http://www.doi.org/>) or Uniform Resource Names (URN, <http://tools.ietf.org/html/rfc2141>).

Metadata interoperability

The following is a MARC metadata fragment provided by the Library of Congress (and encoded as MARCXML):

```
?xml version="1.0" encoding="UTF-8"?>
<collection xmlns="http://www.loc.gov/MARC21/slim">
  <record>
    [...]
    <datafield tag="100" ind1="1" ind2=" ">
      <subfield code="a">Sandburg, Carl,</subfield>
      <subfield code="d">1878-1967.</subfield>
    </datafield>
    <datafield tag="245" ind1="1" ind2="0">
      <subfield code="a">Arithmetic </subfield>
```

A transformation of this fragment to DC yields the following result:

```
<?xml version='1.0' ?>

<dc xmlns="http://purl.org/dc/elements/1.1/">
<title>Arithmetic </title>
<creator>
  Sandburg, Carl,
  1878-1967.
```

And the same fragment rendered in MODS reads as follows:

```
<?xml version="1.0"?>
<mods xmlns:xlink="http://www.w3.org/TR/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://www.loc.gov/mods/"
xsi:schemaLocation="http://www.loc.gov/mods/ http://www.loc.gov/standards/mods/
mods.xsd">
  <titleInfo>
    <title>Arithmetic </title>
  </titleInfo>
  <name type="personal">
    <namePart>Sandburg, Carl</namePart>
    <namePart type="date">1878-1967</namePart>
    <role>
      <text>creator</text>
    </role>
  </name>
```

The example illustrates the fact that these and other metadata formats have originally been developed independently of each other and differ considerably in syntax and semantics; therefore one of the major problems in the domain always has been, and to some extent still is, the lack of interoperability of metadata. A promising approach with respect to syntactic interoperability seems to be the use of XML (eXtensible Markup Language) as a standard syntax for the expression of meta-statements. This has led to the establishment of METS (Metadata Encoding and Transmission Standard, <http://www.loc.gov/standards/mets>) which is expressed in XML and relies on the built-in mechanism for addressing external extensions, the so-called ‘name spaces’, thus identifying each of the standards listed above as a separate namespace and making them subsidiary schemas (which often are called *extension schemas*) of METS. This approach creates some syntactic interoperability across metadata formats but still does not address the issue of semantic diversity: it cannot, for instance, identify the semantic identity of <creator> in DC and of <name> in combination with the subtag <role> in MODS.

This is attempted to some extent by another overarching approach, the Digital Item Declaration Language as part of MPEG-21 (DIDL, <http://www.chiariglione.org/mpeg/standards/mpeg-21/mpeg-21.htm>), but for effectively addressing this issue other approaches are far more adequate (cf. below on RDF/RDFS). Yet another approach for creating interoperability across metadata resources is the OAI-ORE framework mentioned above: ORE enables the modelling of complex objects as aggregations of WWW resources which can be represented by a concept map. It remains unclear, for the time being, which of these approaches will finally be dominant, even though METS – given its librarian origins in the MARC community – currently is the most popular option in the librarian community (cf. below).

A further common approach is currently emerging and may have substantial advantages over plain XML metadata representations, namely expressing metadata statements in RDF and using RDFS for modelling the relevant vocabulary. This is not only a WWW transparent way of expressing metadata but also enables simple semantic web inferencing operations, and thus a kind of simple ‘reasoning’ support which may – among other things – be very useful for automated generation of additional statements. Moreover, the use of RDFS for vocabulary definition may be the real solution for the still widely lacking semantic interoperability of metadata standards (cf. below).

Finally, the recently published draft of the Rules for Description and Access (RDA, <http://www.rda-jsc.org/rda.html>), which are to replace AACR2 and have a much more general scope than traditional librarian cataloguing rules, may have a significant unifying potential and is implemented using RDF in many current testing scenarios.

Although the current situation thus may seem puzzling and irritating to a non-specialist we hope to make more sense of it below!

Business planning for digital library metadata

It should be clear from the above that digital libraries essentially depend on metadata to be operational at all: in the case of textual information objects users may rely on search engine or text mining technology as a low quality substitute – but for image, audio or multimedia objects there currently is no working alternative to metadata based search, retrieval and manipulation of such objects. Metadata thus are a critical factor of digital library operations, but at same time are often considered an expensive one. However, this may be a highly speculative statement: while we know at least some of the major cost factors influencing traditional cataloguing of electronic resources (cf. the implementation of a cost calculation algorithm at <http://www.serialssolutions.com/360-marc-updates-cost-calculator/>) very little is known about the actual cost of generating and integrating metadata pertaining to digital library content.

The cost/benefit ratio in this case is largely influenced by expectations as to the functional quality of operations building on metadata, as well as by the type of objects present in a digital library: in the case of rather low expectations it may be possible to extract most or all metadata features (from textual objects at least) by automated means – but, given a high percentage of non-textual objects and/or very high quality standards, it may be

necessary to generate most or almost all metadata features manually, thus requiring a human intellectual effort comparable to that of traditional cataloguing. The problem here is that digital resources, particularly born digital, are and increasingly will be present on a hugely greater scale than traditional resources, and the human effort required for metadata creation may simply be unavailable.

However, this effort evidently varies considerably depending on the granularity choices being made: creating a DC record with a maximum of 15 attributes for instance may be significantly cheaper than creating a MODS representation of the same digital object.

Finally, relevant metadata resources may be available already for many objects present in digital libraries – as part of other digital libraries or as ‘Linked Data’ on the WWW, freely accessible or at a price. A specific case in this respect is book digitization results as part of digital libraries, where there are almost certainly external metadata available in most cases from which it is technically possible to derive metadata for the digitized objects – but the cost of identifying these as well as the costs for conversion and adaptation may be considerable and the cost/benefit ratio much depends on how neatly digital libraries want to distinguish metadata for the digitized objects from cataloguing data for the originals.

Prospects for the foreseeable future

As stated above, the current situation may at first sight look puzzling, and it remains unclear, for the time being, whether our example fragment will look as follows in the future:

```
<rdf:RDF
  xmlns:marcont="http://www.marcont.org/ontology#"
  xmlns:foaf="http://xmlns.com/foaf/0.1/"
  xmlns:marcrdf="http://www.marcont.org/marcrdf#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
[...]
<rdf:Description rdf:nodeID="A1">
  <rdf:type rdf:resource="http://www.marcont.org/marcrdf#Subfield" />
  <marcrdf:code
    rdf:datatype="http://www.w3.org/2001/XMLSchema#string">a</marcrdf:code>
  <marcrdf:value
    rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Arithmetic
  /></marcrdf:value>
</rdf:Description>
<rdf:Description rdf:nodeID="A2">
  <rdf:type rdf:resource="http://www.marcont.org/marcrdf#Datafield" />
  <marcrdf:tag
    rdf:datatype="http://www.w3.org/2001/XMLSchema#string">245</marcrdf:tag>
  <marcrdf:hasSubfield rdf:nodeID="A1" />
</rdf:Description>
<rdf:Description rdf:nodeID="A3">
  <marcrdf:value rdf:datatype="http://www.w3.org/2001/
XMLSchema#string">Sandburg,
```



```
Carl</marcrdf:value>
<marcrdf:code
rdf:datatype="http://www.w3.org/2001/XMLSchema#string">a</marcrdf:code>
<rdf:type rdf:resource="http://www.marcont.org/marcrdf#Subfield"/>
</rdf:Description>
<rdf:Description rdf:nodeID="A4">
<marcrdf:tag
rdf:datatype="http://www.w3.org/2001/XMLSchema#string">100</marcrdf:tag>
<rdf:type rdf:resource="http://www.marcont.org/marcrdf#Datafield"/>
<marcrdf:hasSubfield rdf:nodeID="A3"/>
</rdf:Description>
```

We do not know for sure today whether plain XML or RDF representations will be the method of choice in the future. Neither can we be sure about the actual uptake of RDA and the way RDA based metadata will coexist with legacy data.

However, the consequences of this uncertainty should be less worrying than one might at first assume, because of a clear tendency that can be observed in the development of digital library metadata standards which are constantly moving away from librarian standardization niches such as MARC and other purely librarian creations into increasingly generic standardization environments such as those controlled by the standardization body of the WWW, the World Wide Web Consortium (W3C). This tendency implies that choices to be made in the future and which rely on these generic standardization approaches are less likely to end up in disruptive scenarios with problematic migration paths. Instead, such choices will always share migration paths with lots of other data and applications on the WWW. At the same time the problems and costs of retrospective conversion or migration should never be underestimated. One essential characteristic, therefore, of economically sustainable digital libraries is standardized, interoperable metadata which are well integrated in the overall information architecture of the WWW.

A second aspect affecting future developments is the fact that digital library resources and their metadata will increasingly coexist with traditional resources and associated metadata in what is often called 'hybrid library' settings (cf. Rusbridge 1998). Among other things this means that when referring to authority data for named entities such as persons, corporate bodies or for concept resources digital library metadata should point to the same resources as do traditional cataloguing data. References to personal names thus could point to the Virtual International Authority File (VIAF, <http://viaf.org/>) and concept links could point to the Library of Congress Subject Headings (LCSH, <http://id.loc.gov/authorities>) – this today is not the case in most digital library metadata and could lead to inconsistent usage scenarios in the future. Again, this represents a substantial challenge for the management of retrospective metadata creation.

A third important aspect is the increasing presence of digital library metadata in heterogeneous settings such as Europeana (<http://www.europeana.eu/portal/>), with co-presence of objects and metadata from conceptually very different cultural heritage domains such as museums, archives and audio-visual collections. This also implies that additional metadata frameworks based on sometimes very different conceptions of objects' characteristics

and context defined in non-librarian metadata frameworks such as Encoded Archival Description (EAD, <http://www.loc.gov/ead/>) or CIDOC – CRM (<http://cidoc.ics.forth.gr/>) will be present there, together with digital library metadata. Creating a coherent user experience under such conditions will be another serious challenge for metadata model designers and for those implementing the models.

Conclusion

It should be seen as wholly positive that the “silos” of isolated digital libraries should be left behind. It is essential to think beyond the ‘collection’ and the narrower community of librarian, archivist or curator in order to show the context of and relationships between different types of objects. All this has substantial implications for metadata frameworks, but the final result will be much more helpful in the long run.

Summary

- Metadata are critical for Digital Library operations, and essential for any operations on non-textual items
- Aligning to generic standards of metadata creation and use is essential for DL business planning
- Such standards currently are built on XML and/or RDF
- The dynamics and instability of the surrounding technology make smooth and inexpensive migration paths a critical factor for DL business planning
- The extent to which metadata creation, conversion or migration requires human intervention or can be done automatically is a key business planning factor
- Metadata models cannot be carved in stone in a situation as digital libraries leave the institutional and community silos and become part of more generic and open web based information architectures.

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