Learning architecture: issues in indexing Australian education in a Web 2.0 world

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Abstract

As Australia's national ICT in education agency, education.au *faces the challenge of indexing web resources, learning objects and teacher-created resources for optimum discoverability by students and educators across all sectors of Australian education. This paper provides an overview of current thinking about learning architectures, and raises questions about how educational institutions are managing the cloud of learning resources currently available.*

Particular issues include how to provide seamless access to the most relevant learning materials from the wide range of resource collections on offer; how to ensure Australian-specific vocabularies are used to describe curriculum resources and how to keep pace with terminology to describe the rapidly changing world of technology in education.

As well as being concerned with traditional concepts of collections, cataloguing and copyright, information professionals in the education sector are now dealing with creation of metadata to describe new forms of learning including collaborative technologies, communities of practice and professional learning events. This paper reports on issues, strategies and a vision for learning architecture that incorporates the best of both worlds.

Learning architecture in Australia

Information architecture

Information architecture is described as 'the practice of structuring information (knowledge or data) for a purpose[1]' [Wikipedia] and defined as 'the art and science of organizing and

[1] 'Information architecture' 2007, *Wikipedia*, http://en.wikipedia.org/wiki/Information_architecture

labeling web sites, intranets, online communities and software to support usability and findability' by the Information Architecture Institute.[2]

It is the concepts of *usability* and *findability* of resources for education that are central to this paper.

edna metadata standard 1.0[3]

Ten years ago, Education Network Australia (edna) was a very early entrant to the web world. It established a robust information architecture to provide what education was asking for at that time: a way to find web content that was useful for educators.

In what was a totally new environment, the edna architects (along with architects of similar initiatives) established an information architecture using philosophies and practices translated from their previous experience, namely the world of librarianship and indexing. Some wise person called it metadata (perhaps so that librarians and indexers had an opportunity to reinvent themselves in the IT era) but essentially the highly standardised and centralised systems of cataloguing, indexing and classifying were adapted to describing and organising online resources, and the edna metadata standard version 1.0 was launched in 1998.

This standard has served Australian education reasonably well for 10 years with minimal changes, facilitating both usability and findability. However, the world of information architecture in education is changing, and the world of the web has changed dramatically. This paper discusses the impact of this change on information architecture and the indexing of education resources.

MCEEYTA learning architecture framework

In education the concepts of information architecture are often combined with elements of technical architecture and referred to as *learning architecture,*[4] similar to the trend for some organisations to refer to a Chief Learning Officer[5] in place of the more traditional Chief Information Officer. There is however plenty that is familiar to information architects in the guiding principles of learning architecture as set out in the MCEETYA[6] policy document for Australian education entitled *Learning in an online world: learning architecture framework:*

- a consistent experience for staff, students, parents and communities
- access anytime, anywhere, by those who need the information
- an authoritative source for each item of information
- a capability for self-service

2 'About us' 2007, Information Architecture Institute, http://iainstitute.org/pg/about_us.php

3 *EdNA metadata standard 1.1* 2002*, education.au* http://www.edna.edu.au/edna/go/resources/metadata/pid/261

4 *Learning architecture framework* 2003, MCEETYA, http://www.mceetya.edu.au/verve/_resources/25aagenda.pdf

5 *Archer College* 2007, http://www.archercollege.com/html/company.html

6 MCEETYA = Ministerial Council for Education, Employment, Training and Youth Affairs

The complexity of the typical technical architecture supporting an education institution is significant with multiple systems and functions at the institutional level including:

- content management systems, including library systems
- learning management systems
- finance and asset systems
- staff and student management systems, and
- assessment and reporting systems

education.au's learning architecture services

education.au contributes several key elements to the national learning architecture for Australian education and training at the systems level with the following services.

Content repositories
education.au has developed and maintains the significant national repositories that are the foundation of the edna,[7] myfuture,[8] government education portal[9], and global education[10] websites plus an increasing number of other national collections.

Content sharing
Aggregation of content to enhance sharing across jurisdictions is a key focus of the *education.au* architecture platform, offering harvesting of metadata records, harvesting of terms to build search indexes and the export of content via RSS, html and javascript.

Search
education.au's Distributed Search Manager[11] enables federated searching across significant but architecturally diverse education collections and catalogues in Australia and internationally.

Communication and distribution tools
email Lists[12] services facilitate distribution of news, communication and discussion amongst 40,000 Australian educators via an integrated web interface.

Collaboration and social networking tools
Groups[13] services provide forums, chats, blogs, wikis, web conferencing, e-portfolios, podcasting and shared webspaces within a secure, supported collaborative infrastructure.

7 *Education Network Australia* (edna), http://www.edna.edu.au/
8 *myfuture*, http://www.myfuture.edu.au/
9 *Government Education Portal*, http://www.education.gov.au/
10 Global Education website, http://www.globaleducation.edna.edu.au/
11 *Distributed Search Manager* (DSM), http://search.edna.edu.au/
12 *edna Lists*, http://lists.edna.edu.au/
13 *edna Groups*. http://groups.edna.edu.au/

Access management
A single sign on[14] implementation that integrates edna services has been in place for two years, with more extensive models for trusted systems proposed.[15]

Domain names
education.au is also the Registrar for the edu.au domain space,[16] an essential element in the architecture, information policy and governance of Australian education.

It is important as information architects and indexers to consider the whole of an information ecosystem, and the preceding discussion aims to provide a national education context. However, it is the content layer of learning architecture that is of chief interest to an indexing audience. This is the layer that includes the fundamentals of the profession: search, repositories, vocabularies and thesauri. Keeping in mind the two goals of **usability** and **findability** what are the key issues for *education.au's* users in these areas, and how are we addressing these issues?

Search

It is sobering to take a tour of the typical content architecture in Australian education today following the issue of *resource discovery*, or a*ccess to information* or simply s*earch*. What is the reality for teachers and students seeking learning resources?

Physical learning resources
The history of automated library systems in education is nearing 20 years. Best practice has been for the library to catalogue all learning resources; except perhaps science and physical education equipment, although in some schools their library management system does indeed double as their asset management system. Practically all Australian education institutions have best practice library catalogue records built to international standards thanks to very high quality and reliable service from the National Library of Australia[17] or SCIS[18] for over 20 years. These MARC records mean a library's data can be used in any MARC-based system, can be transferred between systems and can be shared with other MARC-based systems.

Web-based resources
Since 1996 educators have been faced with decisions on how to organise access to the rich store of learning resources available via the world wide web. Organisations including edna, education departments, SCIS and commercial providers have been cataloguing websites for maximum access by Australia's education and training community. Institutions have also been 'cataloguing' websites on intranets without reference to cataloguing standards.

14 *edna Single sign on*, http://login.edna.edu.au/
15 Hendrick, G 2006, *Trusted services in education: a proposed implementation model*, *education.au* http://www.educationau.edu.au/jahia/webdav/site/myjahiasite/shared/papers/trusted-servicesGH.pdf
16 *edu.au domain registrar*, http://www.domainname.edu.au/
17 National Library of Australia, http://www.nla.gov.au/
18 *Schools Catalogue Information Service*, http://www.curriculum.edu.au/scis

Digital learning objects
Schools, TAFE and universities now have the challenge of other content such as learning objects[19] and with them the advent of content management systems, learning management systems, digital repositories, portals, VLEs and various other terms used by particular systems. Best practice in cataloguing in this environment usually involves Learning Object Metadata (LOM)[20]. Learning Object Metadata typically includes more granular curriculum specific fields than previous cataloguing and indexing systems.

New formats
In tertiary education, and increasingly in schools, provision of full-text electronic journal databases or networked video and music resources means there are several more, largely proprietary, repository systems and corresponding search interfaces to be added to this list.

Integrated search

This is a very simplistic division of types of access to learning resources, but one which represents the current situation for many in Australian education. Basically the architecture is such that a teacher or student who is seeking a resource to support learning is expected to know first where this resource is located, be it the library, the internet, their Learning Management System or another repository, and to choose a particular search accordingly. If they don't know, or if they want to collate resources from more than one source, they must conduct three or four separate searches. For users brought up with one-stop online search engines this is not a sustainable or successful strategy for a 21st century learning environment. This is working against both usability and findability.
There are two basic models for addressing this problem. The first involves aggregating all learning resources in one huge catalogue or repository regardless of format. The other model is to work for an informed, coordinated adoption of standards so that a single search syntax can move across these multiple repositories and return accurate and relevant resources.

education.au has worked on strategies that address this issue in both ways. Using the first model we maintain aggregated content repositories such as myfuture for careers information and edna for learning resources, news and events information. edna has metadata for over 34,000 resources obtained by direct entry and by harvesting metadata from third party collections. This is a labour intensive strategy but one which enables us to do well in the usability stakes as we have total control over the metadata quality and the vocabularies used.

On the other hand, *education.au's* Distributed Search Manager[21] is also successful in giving searchers access to an estimated 1 million resources by searching across multiple collections or repositories including the ABC[22], ACER's EdResearch[23], MERLOT[24], Picture Australia[25]

19 'What is a Learning Object' *The Le@rning Federation FAQ*, http://faqs.thelearningfederation.edu.au/faqs/index.php?module=faq&FAQ_op=view&FAQ_id=43
20 *Learning Object Metadata*, IEEE Learning Technology Standards Committee http://ltsc.ieee.org/wg12/
21 *edna Distributed Search Manager*, http://search.edna.edu.au/
22 *ABC Online*, http://www.abc.net.au
23 *EdResearch Online*, http://www.acer.edu.au/library/catalogues/edresearchonline.html
24 *MERLOT*, http://www.merlot.org/
25 *Picture Australia*, http://www.pictureaustralia.org/

and VOCED.[26] While distributed searching greatly enhances the findability rates for users by returning results from a much larger content pool, this type of search does make it very difficult to ensure relevance of results when searching across collections of different sizes, quality, audience, languages and formats, as well as different metadata and interoperability standards. Another element that is particularly challenging is management of multiple vocabularies.

Thesaurus-assisted search

edna's advanced search[27] seeks to make maximum use of all available metadata and controlled vocabularies, and enhancing this aspect of search is a major priority. Current features include use of *edna-sector* as a way of returning resources for particular audience types, and *coverage* as an important element in the distinction between Australian and international content. A thesaurus assisted search makes use of thesauri to assist users broaden, narrow or refine their search based on terminology and relationships in one or more of the following Australian thesauri: ATED: Australian Thesaurus of Education Descriptors,[28] ScOT: Schools Online Thesaurus[29], VOCED: Vocational Education Thesaurus[30] and AGIFT: Australian Government Interactive Functions Thesaurus[31].

Thesaurus-assisted search is a valuable findability tool but it relies heavily on the availability of see references or use for terms from non-preferred terms, otherwise the user who needs the suggestion most, that is the user whose chosen search term has returned no results, cannot be directed towards a suggested alternative search term.

Vocabulary maintenance

education.au vocabularies

The edna metadata standard 1.0 contained a number of controlled vocabularies using the edna namespace, developed in collaboration with all states and territories and sectors in the late 1990s.

edna-audience:	used to describe the audience group for whom a resource is intended or relevant, eg parent, teacher, administrator, student
edna-curriculum:	used to refine DC.Type for curriculum related publications
edna-document:	used to refine DC.Type for publications and documents

[26] *VOCED*, http://www.voced.edu.au/

[27] edna advanced search, http://www.edna.edu.au/edna/go/search/?SearchMode=advanced

[28] *ATED: Australian Thesaurus of Education Descriptors*, Australian Council for Educational Research, http://www.acer.edu.au/library/edthesaurus.html

[29] *ScOT: Schools Online Thesaurus*, The Le@rning Federation, http://scot.curriculum.edu.au/

[30] *VOCED: Vocational Education Thesaurus*, National Centre for Vocational Education Research, http://www.voced.edu.au/

[31] *AGIFT: Australian Government Interactive Functions Thesaurus*, National Archives of Australia, http://www.naa.gov.au/recordkeeping/gov_online/agift/summary.html

edna-kla:	used to refine DC.Subject to indicate Key Learning Area for school related resources
edna-spatial:	used to refine DC.Coverage to indicate Australian state/territory
edna-userlevel:	used to refine edna.audience to indicate level of education the resource is intended for, eg 0-13 for years of schooling

In 2006 an edna metadata application profile[32] was published to coincide with updating of the edna website, and new vocabularies were added in the ev (events) namespace to support edna and partners' event calendars.

ev-mode:	used to indicate whether an event is being offered in online mode, face to face, or both online and face to face.
ev-type:	an extensive list of event types describing academic year dates, conferences and professional events, recurring commemorations/celebrations and opportunities including competitions and scholarships.

These schemes are published and kept up to date in the *Australian Metadata for Education* discussion Group[33] at: http://www.groups.edna.edu.au/course/view.php?id=1132

New terminology

How can we ensure that our vocabularies are well-maintained and updated to keep abreast of new and changing terminology? A particular challenge for *education.au* as an ICT in education agency is the area of emerging technologies in education. edna-document is an example of a vocabulary that is no longer meeting our needs. How do we show blogs, wikis, online communities, online communities and email lists in this element? edna has an extensive browse structure based on a vocabulary known as edna.category which has been developed in collaboration with sectors and jurisdictions. This is a vocabulary that is much more able to be responsive to new terminology, concepts and priorities in Australian education as edna Information Officers are in a position to develop new categories as demand for the topic from users becomes obvious. However, the challenge in naming new edna categories is to determine the most appropriate term when in most cases there is not yet any term for the concept in an established education thesauri. Issues include guarding against fad words and deciding whether to stay with a very broad term, or to add all the instances of a concept. For instance are wikis and blogs just forms of online publishing, or do they warrant their own term? In education there is an increasingly number of terms where an e- prefix is attached. Is e-learning a significantly different concept from learning, requiring its own term in a thesaurus? How does a thesaurus accommodate an educational philosophy that advocates integration of ICT in education such that a separate term for educational technologies is

[32] *edna metadata application profile* 2006, http://www.edna.edu.au/edna/go/resources/metadata/edna_metadata_profile

[33] *Australian Metadata for Education Group*, http://www.groups.edna.edu.au/course/view.php?id=1132

discouraged? As vocabulary builders we would do well to look to the international guidelines in this area for guidance in the determination of terminology.

Literary warrant

The *Guidelines for the construction, format and management of monolingual controlled vocabularies* ANSI/NISO Z39.19-2005[34] give the following advice in terms of determining literary warrant.

> words and phrases drawn from the literature of the field should determine the formulation of terms. When two or more variants have literary warrant the most frequently used term *should* be selected as the term.

So how should we measure the most frequently used term? Is this frequency of the term in a search of edna, another Australian education repository, or internationally in ERIC[35]? How many hits does a term have to have before it is warranted for inclusion in a thesaurus? Is there a certain length of time that a term needs to have been in use to be included in a formal vocabulary?

User warrant

The *Guidelines* define user warrant as 'justification for the representation of a concept in an indexing language or for the selection of a preferred [subject] term because of frequent requests for information on the concept.' User warrant is determined from the words or phrases being frequently used as search terms by users. This requires careful recording and attention to what users are actually searching for and finding or not finding. National and regional contexts should also be considered when developing subject terms.

Scope Notes

For new terminology it is highly desirable to define the terms as they are included. edna and the Schools Online Thesaurus both have policies that the latest edition of the *Macquarie Dictionary*[36] will be used as the authority for spelling and definitions, and items included in *Macquarie* will not require scope notes in the ScOT thesaurus. However, new technology terms may frequently not be in *Macquarie* by the time we start using it in an online service.

References

To manage multiple terminology while new technologies are 'settling in', see references and related terms are very useful, and particularly so when using a thesaurus to assist search, or in the future to support a move to semantic web functionality.

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34 *Guidelines for the construction, format and management of monolingual controlled vocabularies ANSI/NISO Z39.19-2005* 2005, National Information Standards Organisation, Bethesda, http://www.niso.org/standards/resources/Z39-19-2005.pdf

35 ERIC: Education Resources Information Center, Institute of Education Science, US Department of Education, http://www.eric.ed.gov/

36 *Macquarie dictionary, 4th edition* 2005, Macquarie Library.

Vocabularies and Web 2.0

The preceding discussion deals with issues raised for information professionals and vocabulary services by changes in the terminology of technology. There is however, a more fundamental challenge to address in the near future, thanks to the so-called Web 2.0 environment, where as well as changes in the terminology of technology we are faced with changes in the technology of terminology. It is not just the terms themselves that are changing but the whole method of creating and assigning terms to describe resources.

Web 2.0

The term Web 2.0 is used to refer to online services that include a social component, where the community as a whole contributes, takes control, votes and ranks content and contributors. O'Reilly[37] is credited with the definition of this particular information architecture, in which an improved form of the world wide web is viewed as a platform, with data as the driving force, built through an 'architecture of participation'.

A tour through examples of representative Web 2.0 services such as those in the Web 2.0 logo quilt[38] show how the web is changing and moving towards a place where people can socialise and share resources and knowledge. Central to most Web 2.0 services is functionality that allows users to assign a keyword or descriptor to objects or content, and one of the key building blocks of Web 2.0 information architecture is the tag.

Tags

Definitions of the word 'tag'[39] are numerous and it is interesting to note how many of them provide insight into the multifaceted nature of tags in Web 2.0 applications. Allusion to tags as nicknames or the work of graffiti artists illustrates the informal nature of tags, while reference to html tags and markup language emphasises the technical heritage of tagging. It is presumably from the keywords meta tag that the Web 2.0 use of the term developed, as seen in code such as <META NAME='KEYWORDS' CONTENT= 'education, training, Australia, conferences'>, where meta-tags were designed to give information to search engines or databases for indexing. However a tag in Web 2.0 is not buried and hidden away in a website's source code or metadata record, but is up front and in the face of users. It reveals how users have annotated their own material or other's content, using keywords or descriptors that they believe will enhance findability or categorisation.

Tagging as categorisation

Tags are used in several ways and for different purposes by different services and by different users. Bloggers customarily use tags to categorise journal posts by subject, usually tagging each post with only one, or maybe two, quite specific categories, which become part of a

37 O'Reilly 2005, *What is Web 2.0?* http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

38 *Web 2.0 logo quilt*, http://web2logo.com/

39 'Tag', http://wordnet.princeton.edu/perl/webwn/

browse menu on the side of the blog. These categories are often well thought out, readily understood by visitors to the blog and generally represent a controlled list of topics - unless the author has extremely diverse interests or an extensive blog history. See this example from the blog[40] of Kerrie Smith, Communications Officer at *education.au* with categories outlining key topics of expertise and interest to this blogger. In this case where the content creator is tagging their own content, the prime purpose of the tag is for organisation or categorisation. It enhances findability for the blogger, and one assumes for community of users interested in reading this blog. There is however potential for such tags to be highly personalised or idiosyncratic and of less value to other general searchers.

Possibly the quintessential application employing tagging currently is *del.icio.us*.[41] In this social bookmarking service users categorise websites or bookmarks (or favourites) using tags. For some users the priority is to create unique tags that will mean nothing to anyone but themselves, for instance Year10ASCI as a tag to collect together resources for their Year 10 Science class. Users who are seeking to exploit the social networking capacity of *del.icio.us* will choose tags that mean something to their community or team, so that they can pick up new resources of shared interest. *Del.icio.us* continues to develop its tagging functionality, and features such as tag bundling, tag description and tag re-naming are indications that users of social tagging are recognising some of the issues inherent in vocabulary management, many of which are very familiar to thesaurus managers and have been well documented in the information management literature.

Tagging as description

Tagging is particularly powerful as an indexing tool for the increasing quantity of non-text format content being published online. Indexing is of vital importance to the findability of photographs, podcasts, videos, learning objects and animations. No teacher or student has time to watch every video or listen to a series of 20 minute podcasts to determine their usefulness for a lesson or assignment. Accurate and meaningful subject analysis, description, audience and format information is required. Reviews and ratings are also useful. Tags, reviews and ratings are used extensively and effectively in image library sites such as flickr[42] and video sites such as TeacherTube.[43]

Tagging as indexing

Of course, the addition of keywords to content (be it a website, picture, audio file or video clip) to describe its subject matter is hardly a new concept to information professionals. This activity is simply subject indexing. What is new is that the tagging is being done by anyone. It is no longer the domain of a small group of experts. What does this mean for both the indexing and for that small group of experts?

The following table reviews user tagging against the Australian and New Zealand Society of Indexer's (ANZSI) description of the work of a professional indexer in 'Who We Are and

40 Smith, K 2007, *You are never alone*, http://blogs.educationau.edu.au/ksmith/
41 *del.icio.us*, http://del.icio.us/
42 *flickr*, http://www.flickr.com
43 *TeacherTube,* http://www.teachertube.com/

What We Do.'[44] It is not difficult to see relationships between tagging and indexing as it is defined in this way.

Professional indexing (ANZSI)	User tagging	
the provision of locators	✔	hyperlinks used to provide locators
make it easy as possible for someone to find what they are looking for	✔	tags can be searched and browsed
within a large collection of information	?	debate about how scalable tagging is in a large collection, tag clouds are not always scalable[45]
involves semantic analysis	✔	although the rigor of semantic analysis may be more variable
indexer determines the meaning of the material in the collection	✔	tags focus on individual items more than the collection as a whole, but they can show relationships between items
finds ways to summarise and represent meaning in an easy-to-use form	✔	tags are easy-to-use summaries of meaning to the particular user or their community
linked to the original information	✔	tags usually visible on the original source
locators provide quicker / easier access to smaller units	✔	tags can be quicker to navigate than printed indexes
not just a concordance or full text search system	✔	user tagging provides good visual alternative to full text searching
locators follow a meaningful sequence, which is usually alphabetical	✔	various sequences are usually available, alphabetical and frequency

Folksonomy

One major difference between professional indexing and the tagging taking place in Web 2.0 is that indexing generally involves use of a controlled vocabulary, taxonomy or thesaurus, while social tagging is much less likely to employ such a tool. This distinction is not obvious from the description of the professional indexer used above, but I believe it is one area that warrants further attention. How important to findability and usability is the consistency of description strived for by the use of an authoritative, controlled vocabulary as opposed to the user-specified terms employed in social tagging systems?

Folksonomy is a term used to refer to 'user-generated classification associating keywords with content.'[46] The term has obviously derived from the concept of taxonomy, and the idea of a vocabulary that develops from a particular community of users, rather than an external authority. A simple example of where folksonomy is employed effectively is Attendr[47] where

44 'Who we are and what we do' 2007, ANZSI. http://www.aussi.org/administration/aboutAusSI.htm

45 Shanks, P 2006, *extisp.icio.us tag cloud* http://www.flickr.com/photos/botheredbybees/259548406/

46 *Folksonomies*, e-government Victoria, http://www.egov.vic.gov.au/index.php?env=-categories:m1124-1-1-8-s&reset=1

47 *Attendr*, http://www.attendr.com/

users agree on a tag to use for a conference in order to gather all participants' online activity and comments around the conference.

Research into the relative quality and applicability of user tagging, reviewing and rating is limited, not surprisingly given the relatively recent advent of this activity. There are some interesting applications such as Google Image Labeler:[48] which aim to improve the quality of tagging. Users are randomly paired with an online partner and over a 90-second period, both are shown the same set of images and asked to provide as many labels as possible to describe each image. When both partners provide the same label this is considered to be a representative tag which should be added for that image.

Librarything[49] is a special case which combines the two worlds of MARC catalogue records and social tagging to provide an enhanced cataloguing and community service centred on books. Perhaps this service could be a source of data about the relative merits or effectiveness of controlled vocabulary terms and user tagging, by comparing the relevance of hits returned from catalogue terms with those returned from user tags. Such research is vital for informing future information architecture and allocation of resources to improving indexing, thesaurus development and search. Questions that arise include what do folksonomies have to offer thesaurus developers and indexers, and what does a thesaurus like ScOT have to offer social tagging?

Taxonomy Directed Folksonomy

This last question was addressed recently as part of an edna personalisation project, by Nick Lothian, technical architect at education.au who developed a proof of concept for what he calls a taxonomy directed folksonomy.[50] This was an attempt to combine a taxonomy, in this case the ScOT thesaurus, with user tagging. When tagging a resource the user is shown appropriate terms from the thesaurus in the hope that if a term shown meets their needs, they will select a term from the thesaurus over a non-preferred version which they might have used had the thesaurus term not been 'in their face'. Of course, if the thesaurus term does not meet the user's need, they can continue to input their preferred term. The benefits that a thesaurus provides in terms of broader, narrower and related terms are passed on to the user, and hopefully the use of non-preferred terms is reduced. In future development it is envisaged that the thesaurus managers can review the terms contributed by users where an appropriate thesaurus term was not found, and use this information to improve the thesaurus.

RSS: Subscription as alternative to search

Another keystone in Web 2.0 architecture is content delivery via RSS. RSS stands for Rich site / Really simple syndication, and enables users to subscribe to online content and have it delivered to their desktop. By subscribing to services that provide content that is regularly updated such as news, events, music or episodes of a radio or television programme, users keep up to date with their chosen topic or show. In addition to the immediacy benefits of this

48 *Google Image Labeler*, http://images.google.com/imagelabeler/
49 *Librarything*, http://www.librarything.com/
50 Lothian, N 2006, *Taxonomy directed folksonomies*, http://blogs.educationau.edu.au/nlothian/2006/12/13/taxonomy-directed-folksonomies/

functionality, and the personalisation it offers, there are also major impacts in terms of resource discovery. Users can subscribe to tags or keywords to further customise the content they receive. This represents a convenient alternative to searching for content, particularly for topics where the user wishes to keep abreast of new developments and content over time. For this user, there is an assumption that the tag they have chosen to track is in fact a representative enough term to produce a comprehensive set of results. While this may work well for an agreed folksonomy term such as the tag for a conference, for more general topics subscription via RSS usually involves elaborate search syntax, subscription to multiple feeds to cover all bases or restriction of feeds to tags from trusted colleagues only. This is a case where wider use of a controlled vocabulary would be highly beneficial to improve the probability that the term subscribed to will return highly relevant and usable content.

The future: Indexing 2.0

One intention of this paper in considering the key elements of information architecture in an online information service such as edna, and tracking changes over the past ten years, was to consider or predict what might be key elements of online information architecture in the future. It seems that more questions than answers have been generated in considering what implications this has for our work, and where we go from here? While the paper has concentrated on Web 2.0 and the possible impact of user tagging on the future of indexing, it is important to acknowledge also the potential of automated processes to dramatically change indexing and information architecture in the future. Browne[51] describes this as a 'decrease in human indexing and rise in Machine-Aided Indexing (MAI), in fully automated indexing and in the absence of indexing (replaced by free-text, full-text search).' Comparing the usability and findability of this machine-generated from full-text format versus the more traditional human indexed metadata format is one more area requiring ongoing research. The US Presidential Speeches site[52] is an interesting example where tag clouds generated by largely automated machine indexing of text are 'mashed-up' in a timeline format and presented in a highly visual manner, creating a completely new and extremely powerful information product for history students.

The challenge I am left with is how we create a future where large scale creative and functional online services are developed that combine the best of each of these approaches to indexing? Namely the ease, power and speed of the automated indexer plus the high quality, value-added and standards-focused data returned by the professional human indexer, as well as the user-centred, popular terminology of the social tagger.

[51] Browne, G 2007 'Convergence: the future of indexers and other professionals' *Information Online 2007*, http://www.information-online.com.au/docs/Presentations/infoonline_paper.pdf

[52] Mehta, C 2007, *US presidential speeches tag cloud*, http://chir.ag/phernalia/preztags/