EnCoRe: Final Report

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Section 1: Overview

Background to proposal / project

The University of Derby has been a leader in the development of both e-learning courseware and the supporting technical and organisational infrastructure, as well as in the development of a large and sophisticated digital library. A number of developments have been notable in this respect:

- The School of Health at Derby made some of the earliest uses of interactive multimedia CD-ROMs to support HE programmes.
- Derby has been using a VLE for almost six years, initially using Learning Space then replacing it two years ago with a home-grown platform, DEPOT.
- Derby now has the second largest portfolio of online courses of any UK HEI, delivered via the Global University Alliance and the UKeU.
- As of September 2003 DEPOT has now been subsumed into an institution-wide MLE, UDO (University of Derby Online) which integrates *inter alia* library systems, courseware and discussions groups, and the student records system behind a new portal. Derby is one of the first institutions to launch a true Managed Learning Environment.
- The Telepresence Teaching Centre is unique and a technical tour-de-force, with five satellite TV studios broadcasting live lectures across a variety of disciplines to over 4000 students at multiple sites in Israel. Lecturers operate the studio equipment themselves, switching between camera, PC and VCR sources. There is a return video signal so that lecturers can see and talk directly to individual students.
- Derby has one of the largest collections of copyright cleared electronic resources in UK HE and our processes for the use of these resources are considered a model for other institutions.

Over the last year restructuring has taken place at Derby, bringing together the Library and Learning Resources (LLR), the Centre for Educational Development and Media (CEDM), the Centre for Interactive Assessment Development, and IT Services into one merged department, reflecting both the convergence of technologies and the interdependence of these different operations. But prior to the restructuring teams from LLR and from CEDM had already begun working closely together, examining how the processes for clearing and exploiting the Library's electronic resources could be better integrated with CEDM's e-learning systems, resources and courseware.

This working group had started to consider e-learning standards, metadata, the learning object approach, and related issues in the conceptual territory between the cultures of the librarian and the e-learning developer / instructional designer, so when the DiVLE call came out from JISC, it was seized on with enthusiasm as an opportunity to work on some of the ideas that had already been discussed. Moreover, at this point in July / August 2002 the University's MLE project was just starting, building on the existing VLE and other systems, so the call was timely in all respects.

Aims of the project

Against the background outlined above, the project had a number of general aims connected with the recognition of a need to develop a shared understanding between two cultures that had previously operated independently. At one level librarians and e-learning developers needed to be comfortable talking the same language, with librarians starting to use terms such as 'learning objects' and e-learning developers learning terms such as 'Z3950'. EnCoRe generated an internal forum in which this exchange could take place, as indeed the programme as a whole did for the HE community.

In addition to arriving at a shared understanding of how digital libraries can work with (within) MLEs, the team hope to go some way towards an actual operational integration of UDEL (and other library resources at Derby) with UDO. Specifically, we wanted to develop a set of tools for both students and academics which would eventually become menu items in UDO,

enabling the user to search disparate collections of resources seamlessly, to annotate and cross reference sources, to generate bibliographic and course documents.

Depending on access privileges users would be able to:

- search and access at top-level all available electronic resources
- create bookmarks
- annotate bookmarks
- search bookmarks and annotations
- add documents to reading lists
- send bookmarks to individuals or groups
- send bookmarks to an MLE discussion group
- request copyright clearance for key texts.

The tools would provide an academically oriented mechanism for linking course related (VLE) requirements to internal and external digital library collections through a single interface. The concept was to be based on utilising emerging OpenURL standards for web documents and other items, supported by 1CATE: 1 Click Access To Everything – a commercial OpenURL subscription service developed in the US by Eric Hellman of Openly Informatics. 1CATE uses context sensitive open link technology to identify a user-specific information object from its metadata located elsewhere on the web. Derby was the first UK university to employ this service in stand alone mode.

In order to include non-formal resources such as lectures notes, resource-based learning activities, examination papers and multi-media objects a development of generic extensions to the current OpenURL tags was envisaged which would adhere to the Dublin Core metadata elements and SCORM learning object metadata.

We also aimed to provide a new MLE facility for a unified top-level search of all electronic resources. This would be made possible by the development of a web-enabled Oracle database storing links to the resources whether internal or external, allowing:

1. inserting, updating and deleting of resources via a web interface
2. define how the records will be displayed to the end user via a web interface
3. create an interface to the database usable by other applications.

Finally, we aimed to work with HERON on refining the processes (online and other) involved in the clearance of electronic texts for use in VLE / MLE 'coursepacks'. Derby is one of the largest HEI customers of HERON, which is itself the main clearance agency.

Stated deliverables

- A generic toolkit which could be used by other HEI's to link digital library and VLE/MLE development based on Open URL standards
- An Oracle database file and series of scripts to interface with the database
- A website to disseminate ongoing information about the project, conference and journal publication as appropriate, and final report
- Contribution to development of Open URL standards

Project achievements

Project EnCoRe has had the following successes:

- Project website at http://lib.derby.ac.uk/encore/encore.html . This has been regularly updated and includes code that the project has generated plus entity relationship diagrams for the main Oracle database.

- Dissemination via programme meetings, visits (to Patras in Greece), articles, and two EnCoRe / HERON days at Derby, both of which were attended by around 50 people.

- Metadata: Development of an application profile of Dublin Core to describe Library and Learning resources. Development of a Dublin Core based database (see below). Metadata templates for the three kinds of resources: library guides, exam papers and study skills guides. Database testing by the metadata cataloguer/input of sample records from the library guides and study skill guides. Development of an application profile of IEEE LOM to describe learning objects. Development of a metadata form to appear in the learning object generator tool.

- Completion and testing of the Oracle database.The DB records hyperlinks to, and meta-data pertaining to, disparate internal resources such as Exam Papers, Images, and other electronic resources. The range of fields specified by DC enable searches on resources to be done based upon various details, such as 'Creator', 'Subject' and 'Description'. This results in a far more powerful search than is possible through the usual 'keyword' search typically employed within university resource searching facilities. Furthermore, the database launches a search into our accessible journal holdings, via our OpenURL provider and project partner Openly Informatics.

- URL-Cart: A facility to take the URLs of resources found via a search of the Meta-Data Database (including the urls of journal articles, in the form of OpenURLs) and save them into a personalised database of links (so each user of the system can store their own links). This facility is complete and integrated with the University's Managed Learning Environment.

- Learning Object Generator: A facility to enable both technical and non-technically minded academic staff to create Learning Objects. These learning objects will be based upon resources found through the Meta-Data Database. They will eventually be exportable to certain meta-data/content packaging standards. Once Learning Objects have been created, a repository should be searchable, enabling academics to use one-another's objects, saving them from re-writing similar components, and enabling them to easily create course-packs. Development of the first working version is 80% complete and will continue beyond the end of Project EnCoRe.

- Copyright knowledgebase: a set of webpages for staff to refer to when working with electronic resources using EnCoRe and other tools within the MLE.

Impact of project

In its general aim of fostering a shared understanding and dovetailing working practices between departments at Derby the project has certainly been successful. In the new merged Learning and Information Services department the boundaries between roles that previously existed have now been blurred or removed altogether and EnCoRe has contributed greatly to this.

Fifteen months ago very few people in the institution were aware of concepts such as learning objects or metadata but they are now in common parlance (if not necessarily fully understood). This growing awareness has coincided with work commencing at Derby on development and delivery of online programmes through the UK e-Universities, whose platform is based on a learning object approach, requiring a whole new way of thinking about materials from academics and developers. In this sense EnCoRe has helped prepare the ground for an important new initiative.

As far as the project's impact in the wider community of specialists is concerned, this remains to be seen, but we can at least point to two very well attended EnCoRe / HERON days at Derby, with over 100 visitors in total. These visitors were interested in what we were already doing with the copyright clearance of electronic resources as much as by specific EnCoRe developments but we would expect specialists to take some note of our observations on OpenURL and of our metadata work in particular.

Critical issues and changes

Issues encoutered along the way can be divided into two categories: (a) practical / logistical and (b) technical / conceptual.

(a) As noted in the formative reports regularly submitted we struggled to some extent with recruiting staff. This was connected partly with bureaucratic HR / finance procedures and partly with the fact the the senior web application developer left in mid-December 2002 after only two weeks because she had found a permanent full-time job closer to home.

Finance department bureaucracy has also been an obstacle in other respects, but might have been less so if the project had been longer and if there had been more time to prepare before the start of the project.

Another difficulty lay in the fact that neither of the two project managers had as much time as they would have like to devote to the project, both having other units to manage. Furthermore, one of the managers was away on sick leave for three months of the project. For any future JISC (or other) project we would advise colleagues at Derby (or elsewhere) to include provision for a full-time project manager, albeit one who might get involved with day-to-day technical development as well.

With hindsight it would be fair to say that in the time allowed we set ourselves too broad a task for such a short project. The original team members are good creative thinkers which did present the challenge of remaining focused on our original aims and objectives. This was resolved by designating ideas as part of the original brief and 'doable' by July 2003; as part of ongoing developments within the UDO project; or as good ideas for revisiting in the future for research and development.

(b) Project EnCoRe has diverged to some extent from what it set out to do, notably in relation to the application / extension of OpenURL. Specifically, and after lengthy consideration, we took the decision in Spring 2003 not to proceed with the application of OpenURL to searching for learning objects (and, as a corollary, the extension of the OpenURL framework). This decision was not taken lightly and was preceded by many hours of debate among the team members.

In the end the critical influence in the process was that of the external consultant, Eric Hellman of Openly Informatics, who - although he has been a leading player in the emergence of OpenURL - advised us that at this point such an application of OpenURL was interesting for research purposes but that it would not have an immediate real-world benefit. (See below for expanded reasons.) We intended to return to this application of OpenURL as a theoretical exercise towards the end of the ten months but time ran out as team members concentrated on finishing other parts of the project.

One disappointment with the project was that we were not able to do more with refining the processes connected with the clearance of electronic resources through HERON. Full details are given in CIRT's document evaluating Project EnCoRe which accompanies this final report. The lack of progress in this aspect of EnCoRe perhaps reflects the difficulties that can occur in communication between two organisations that are both restructuring. We also recognise that more might have been achieved here had there been a memorandum of understanding. Nevertheless, Derby is still one of the leading HEI users of copyright cleared electronic resources..

Another aspect of EnCoRe where the team took the decision to refocus efforts was in the use of the toolkit for annotation and cross referencing of resources. There were two reasons for this: firstly, Derby's MLE project (UDO) has taken care of some elements of this, in what is currently a relatively unsophisticated way but which it is envisaged will be developed further in the next phases. The EnCoRe team were reluctant to duplicate, or overlap with, this work which had taken place between the time of the proposal and December 2002 when the project really got underway. Moreover, in our desk research we identified Net Snippets (www.netsnippets.com) as a relatively inexpensive tool that was already being marketed to

HEIs and which covered much of the resource annotation functionality that we had aimed to develop. It is likely that Derby will be purchasing a site licence in the coming year allowing the software to be used by staff and students as an adjunct to UDO / EnCoRe. We would also recommend it to other institutions.

In some areas of EnCoRe we feel we have achieved more than we set out to do. In particular, the work that has been done on metadata, including the development of the University of Derby Metadata Application Profile, should prove to be a useful contribution to the field. In association with this, significant time and effort has gone into the Learning Object Generator.

The speed at which developments and changes are happening with regard to metadata in particular IMS meant that the development of the schema kept changing. The development of IMS learning design led to healthy discussion within and outside the project. This made it difficult for us to remain fully focused on our aims for the end of the project. While working with learning objects there was a desire to move beyond the focus of the EnCoRe project to do further work on the rights management issues surrounding the use of material in a learning object, the problems that arise from licenses held by host institution and those external institutions who wish to use a learning object from the repository.

Another issue that arose was doubts over the time and inclination that academic might have for metadata entry. How accurate would the metadata be? How much meta-data already attached to a resource could be 'defaulted' into the new learning object? How can the quality of the metadata be checked by software and also by a human? What is the quality of the metadata in the final wrapped package?

Finally, as is apparent in CIRT's final evaluation report, there was a clear divide in the project team between those who saw it as an academic research and development project and those on the technical side who viewed it as a typical IT project. While members of the team co-operated well both professionally and personally, there was a tension between the desire to achieve something practical that could be used as part of the MLE and the wish to explore issues at length without necessarily resolving them. The project managers - and CIRT's evaluators - feel that this is a generic problem with projects which are both research-oriented and intended to result in working systems. In the case of EnCoRe / DiVLE, this was of course compounded by the fact that the programme only lasted 10 months.

Management and Organisation

As the project involved staff from two separate departments, CEDM (Centre for Educational Development and Media) and the LLR (Library and Learning Resources) it was decided to have two managers, one from each department. (As it turned out this was a prudent decision because of the lengthy sick leave and convalescence of one of the managers!). One oversaw the day to day planning and organisation and administrative functions and the other took responsibility for staffing, finance and technical issues and development.

In preparing the bid the team had taken heed of JISC's advice on the difficulty of recruiting suitable staff to work on the project, namely to ensure that in the case of difficulty in appointing members of staff their functions should be able to be undertaken by members of the team. To this end each member of the team had a particular interest and responsibility. This was sound advice from JISC as it was necessary for team members to take on some of the tasks because of the delay in appointing development staff.

Fortnightly team meetings were held which were fully minuted but it was deemed necessary in the closing months of the project to increase these to weekly meetings.

Reports were prepared and submitted to JISC as requested and these also formed the basis for the reports to our internal monitoring group, the e-learning technical group.

Dissemination

At the beginning of the project a website was developed and maintained throughout the project. It is intended that this will remain current for at least 2 years. It is available at www.lib.derby.ac.uk/encore/encore.html.
Two events were held at Derby; EnCoRe/HERON : the Derby way to electronic course packs on January 21st 2003 and May 19th 2003.

A presentation was made by two members of the team at a day's workshop, "The Active Role of Libraries in Web Based Education", at the University of Patras, Greece, on April 11th 2003. Representatives from the EnCoRe team have also taken part in a variety of other events including Cetis events, these include the meetings for the special interest groups for educational content and metadata.

An article was published in Assignation in April (20 (3) April 2003). Two further articles are being prepared. One is for the ARIADNE Conference to be held 18-21 November in Belgium. Submissions were also prepared for CERLIM'S Libraries Without Walls conference in Greece in September 2003 but this was unsuccessful. However, the paper is to be modified for publication as an article in Emerald's 'Library Review' sometime in 2004.

Team members have also participated in events organised by the programme group and JISC.

External Evaluation

CIRT (Centre for Information Research) were employed to carry out an external evaluation of the project. This proved to be a very beneficial experience. The CIRT team were involved with EnCoRe from the beginning of the project and attended team meetings each month. They carried out a series of interviews at various times during the project. The outcomes from these interviews certainly helped the team to remain focused on their stated aims and to question the way in which the project was going. Feedback to the managers also assisted in the running of the project. We would recommend to other institutions considering making a bid to JISC that they include external evaluation of this kind in their proposal.

The final report is attached to this document as an appendix.

Project continuation

Now that JISC DiVLE funding for EnCoRe has come to an end, the project has been absorbed into Derby's UDo MLE development. Some EnCoRe functionality (eg the URL shopping cart) has already been integrated into UDo; further work will focus on progressing from testing the metadata database into populating and using it.

Work on the Learning Object Generator will also continue and we hope to have academics trialling the first version by mid-November. It is hoped that this will become a key feature of UDo. This is partly dependent on further work in the area of learning object repositories.

Derby continues to use Openly Informatics' 1CATE OpenURL service and will regularly re-assess whether it would be appropriate and beneficial to extend this use.

The project website will be updated at intervals with news of these developments.

Section 2: Functional Description

Metadata

The University of Derby had two areas in which we wished to apply metadata.

1. Learning and Information Services. The resources to be described for the purpose of the project were:
   Exam papers
   Study skills guides
   Library guides

2. Learning objects produced by a Learning Object Generator. Initially these objects would be resource-based.

We wanted to facilitate the seamless searching of these disparate resources and the original plan was to hybridize the Dublin Core and IEEE LOM metadata element sets. However, this was not found to be satisfactory.

Instead a new approach was adopted which concentrated on the use of element mappings. A Dublin Core based database was developed to house metadata records for these resources. Full description of the Learning and Information Services resources could be achieved by using the Dublin Core Element Set and would be held as such. They could also be exported as IEEE LOM records if required. Learning objects would be described using a profile of the IEEE LOM standard which would be SCORM conformant in that the profile would contain all the mandatory elements for a Shareable Content Object (SCO). They would still be searchable in the Dublin Core database however, on the fields where IEEE LOM and Dublin Core fields map. Further, more detailed, searching of learning objects would be made via a separate Learning Object Generator search interface. In addition to the metadata of the IEEE LOM, learning objects would also be pre-tagged with some basic IMS Learning Design elements for searching and for future use in a full implementation of IMS Learning Design. These IEEE LOM records would be held in a learning object repository.

The project aimed to supply accurate, high quality metadata for its electronic resources. This was achieved by automating the creation of metadata to prescribed rules as much as possible and by formulating and applying existing rules for forms of entry to data input.

University of Derby Metadata Application Profile: Library and Learning Resources

This part of the application profile used a subset of the Dublin Core Element Set.

Dublin Core Element Set

1. DC.Title
2. DC.Creator
3. DC.Subject
4. DC.Description
5. DC.Publisher
6. DC.Date
7. DC.Type
8. DC.Format
9. DC.Identifier
10. DC.Language
11. DC.Relation

12. DC.Rights
13. DC.Audience

Metadata: University of Derby Metadata Application Profile for learning objects

This part of the application profile contains a subset of elements from the IEEE Learning Object Metadata Standard.

It is SCORM (Shareable Content Object Reference Model) conformant (Version 1.3 : Draft) as to the minimum requirement for a Shareable Content Object (SCO) in that it contains all the mandatory metadata elements required by a SCO.

It also implements all the mandatory fields outlined by the UK LOM Core

Full details are given in the Appendices.

Metadata: standards

DC did not require customization; it was merely a matter of selecting appropriate elements for the resources.

IEEE LOM: As the LOM did not express various educational concepts new purposes (and associated vocabularies) were devised for the Classification element and new vocabularies for existing Classification purposes. This allowed for Learning Design type information to be recorded.

Metadata forms were devised for all the resources. A metadata template for the LO's appears on the tool after the activity has been created. This was devised to aid the capture of consistent, high quality metadata from the academic users of the tool.

Metadata: future work on DC

- Further refinement of the database.
- Further testing of the database by interested parties. (Subject advisors, cataloguer)
- Input of data.
- Production of a user manual.
- Production of training guidelines/notes.
- Metadata validation.
- Input of data from other areas, eg NetLibrary.
- Export/import of metadata records (metadata harvesting).
- Responses to feedback from trialling.

Metadata: future work on IEEE LOM / Learning Objects

- Development of the tool.
- Trialling of the tool.
- Production of a user manual.

- Production of training guidelines/notes.
- Development of a repository for the records.
- Development of an interface for this repository to add in annotations, peer reviews, quality assurance etc.
- Identifiers for the learning objects.
- Formation of a quality assurance process. Metadata description of quality assurance.
- Rights management. Possible implementation of digital rights description (eg Digital Rights Expression Language)
- IEEE LOM (Final) binding. This will not be available for some time.
- Accessibility issues.
- Possible implementation of IMS Learning design.

Metadata: general issues for the future

- The harmonization of the production of application profiles (see BS8419).
- IMS Resource List specification
- Vocabulary exchange. IMS Vdex.
- Semantic interoperability, mapping etc.
- Developments to produce a learning resource type vocabulary suitable for UK FE/HE.
- Secondary metadata, eg Who used what and when.
- Object identifiers and the ramifications of moving objects around. (Allocation is easy but the management and resolution is more costly).
- Metadata content quality.
- Digital Rights Expression Language. Information on what this should contain is being gathered now.
- Need to keep up with metadata developments which are coming thick and fast. Membership of SIGs, discussion groups, external interested bodies (eg CETIS) very important.

It is important to research an implementation of metadata comprehensively, with due consideration of all the issues at the earliest stage. Building flexibility into profiles and databases is very important as the metadata will evolve over time. There is also a point at which the work needs to be translated from theory into practice. Real-world application of metadata reveals problems that may not have been apparent at the theoretical stage.

Researching how other projects have approached metadata is essential. They can provide a starting point for your own implementation and help you avoid common pitfalls.

As so many implementations have community specific issues to resolve, the problem of interoperability comes into play. Mapping metadata would seem to be the way forward but

this raises further issues. Mapping elements is fairly simple but can semantics be standardised? We believe that (currently) human intellectual input will always be necessary for this kind of work.

Metadata quality is critical; a validation process required so that metadata does not negate its usefulness by being inaccurate and therefore "invisible".

Database: description

The EnCoRe Meta-Data database is a Dublin-Core (DC) meta-data set based repository for cataloguing data about existing electronic resources, that enables the search and retrieval of said resources. Resources can be searched within the system according to detailed meta-data such as creator or subject area, or by using a straightforward keyword search on the title and description. The advantage of the system is that it not only enables the university (or any other owner of a copy of the system) to record and search for all of its existing resources from a single place, but it enables different users to search in ways which are appropriate to their needs. So for example, a student may with to search for all resources that match their subject and their level (say, business year 2), while a lecturer may wish to find all resources created by a given colleague, say "James McNulty". The system enables numerous searches in various formats such as these, and also enables simple keyword searches, which many users are used to.

The system records DC meta-data about each record catalogued, along with the URL to link to that resource. Therefore, it relies upon every resource being accessible via a URL. However, the system could also be used to access resources stored in existing systems that cannot be selected by a URL – this would require a minor modification to the way those systems work, replacing a HTTP POST operation with a HTTP GET operation (so for example it may pass a unique id in the format of http://madeup.derby.ac.uk/resourcesearch?id=22)

The system includes functionality to save URLs records via the URL-Cart, and search results from our OpenURL provider.

Database: technologies

The system was designed using MS-Access, and developed in Oracle using PHP to create the web front end. Designing in MS-Access enabled the developers to work iteratively with the project's meta-data cataloguer in deciding exactly how it should work, so that the final system could be developed according to set design plans. The system also uses some JavaScript to enhance client end functionality.

The design and SQL used were kept very simple and standardised, so that the system could easily be hosted, used and modified by other educational institutions. Code, diagrams and further explanations are available from http://lib.derby.ac.uk/encore/encore.html .

Database: metadata standards

The system is based upon selected elements from the Dublin Core. The meta-data cataloguer made these selections based upon experience within the university's library environment. See the metadata section above for further details.

Database: aims achieved?

The system largely achieved the aims set out in the original proposal, although due to time constraints full testing has not been performed, and some areas have not been fully implemented. However, these are all areas that can quickly be resolved at Derby as EnCoRe is absorbed by UDo.

Database: extra functionality

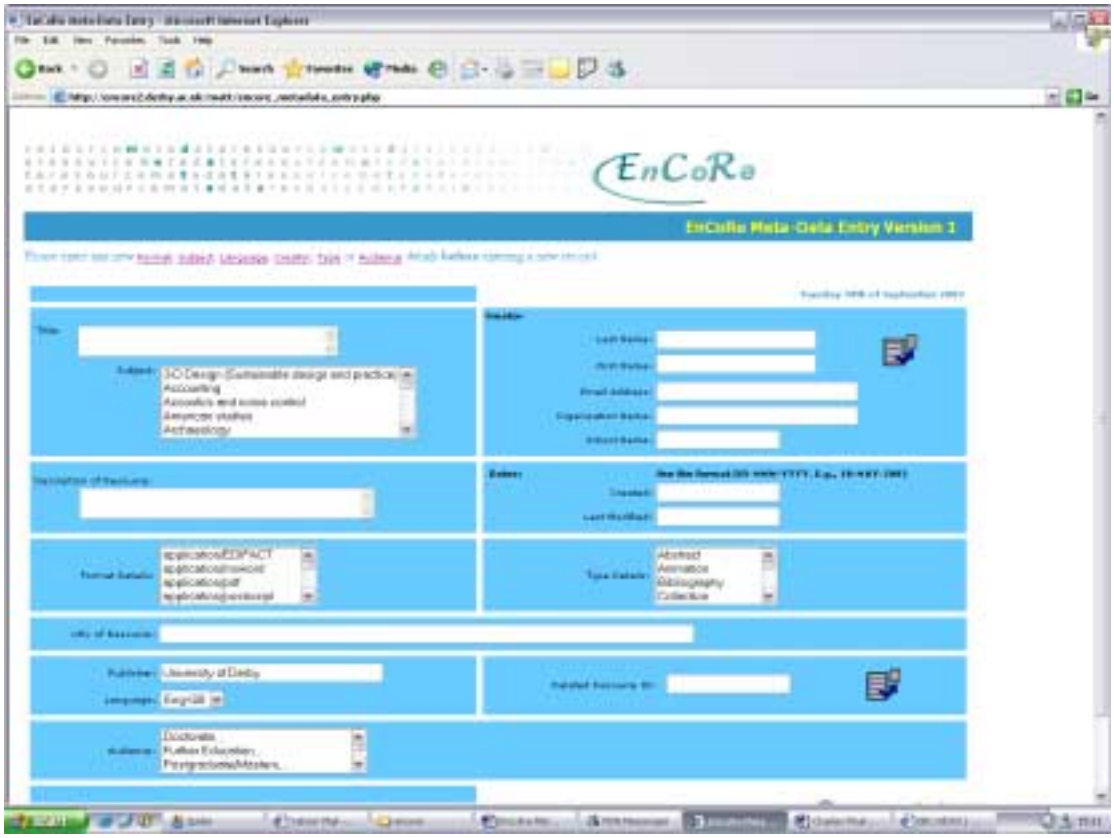
The system has some additional functionality in the form of meta-data harvesting. This represents the ability of copies of the system to exchange their records with each other, and also to exchange records with other DC compliant systems. Meta-data can be harvested (ie saved) to a simple XML format, and then passed around, and uploaded into the system. The aim of this functionality is that different organisations or institutions can swap their records, saving themselves from having to catalogue work that has already been catalogued. This, of course, assumes that the receiving organisation has access to and desires to catalogue records existing in the system of the sending organisation.

This functionality was being investigated towards the end of the project, and currently only exists in a fairly simple and untested form. However, essentially it works and could be extremely useful.

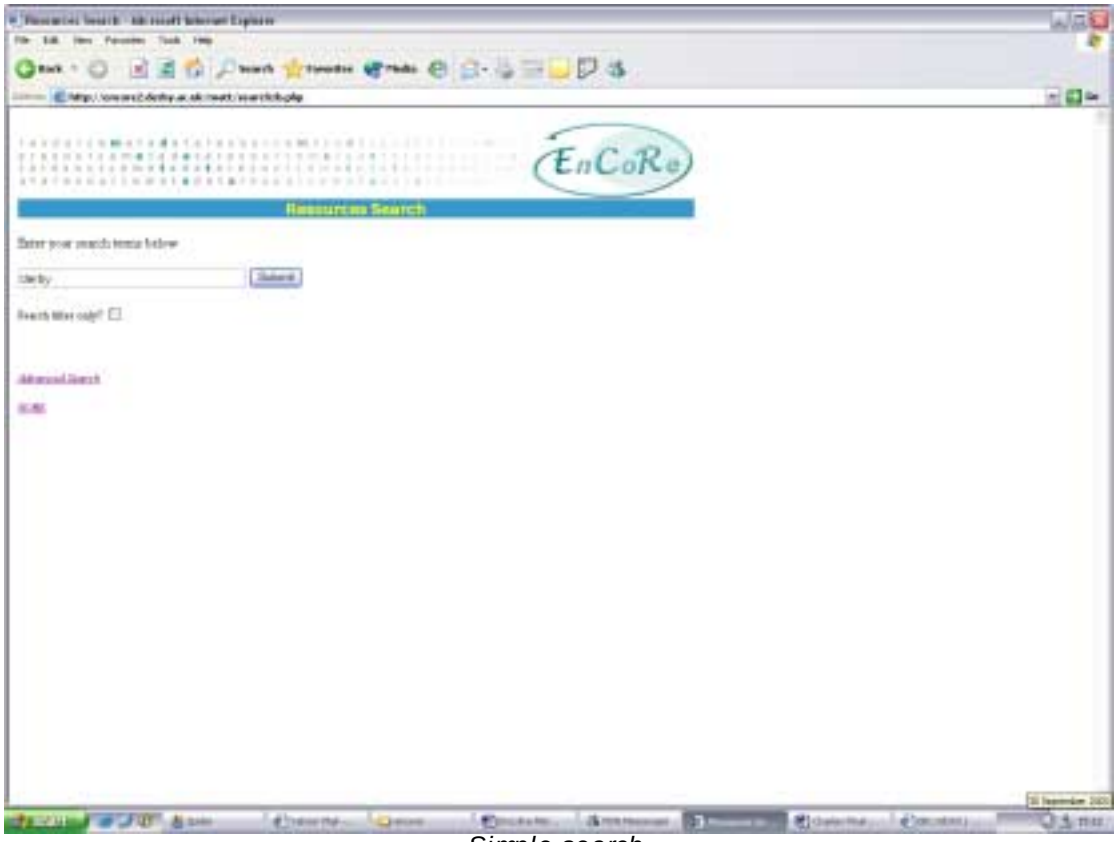
Database: future

The system could be hugely beneficial to any organisation that has disparate electronic resources, and could easily be modified to take into account disparate non-electronic (ie., real-world) resources such as books, CDs, files etc. It is based upon a simple design, and so can be easily modified to fit different meta-data element sets and different uses.

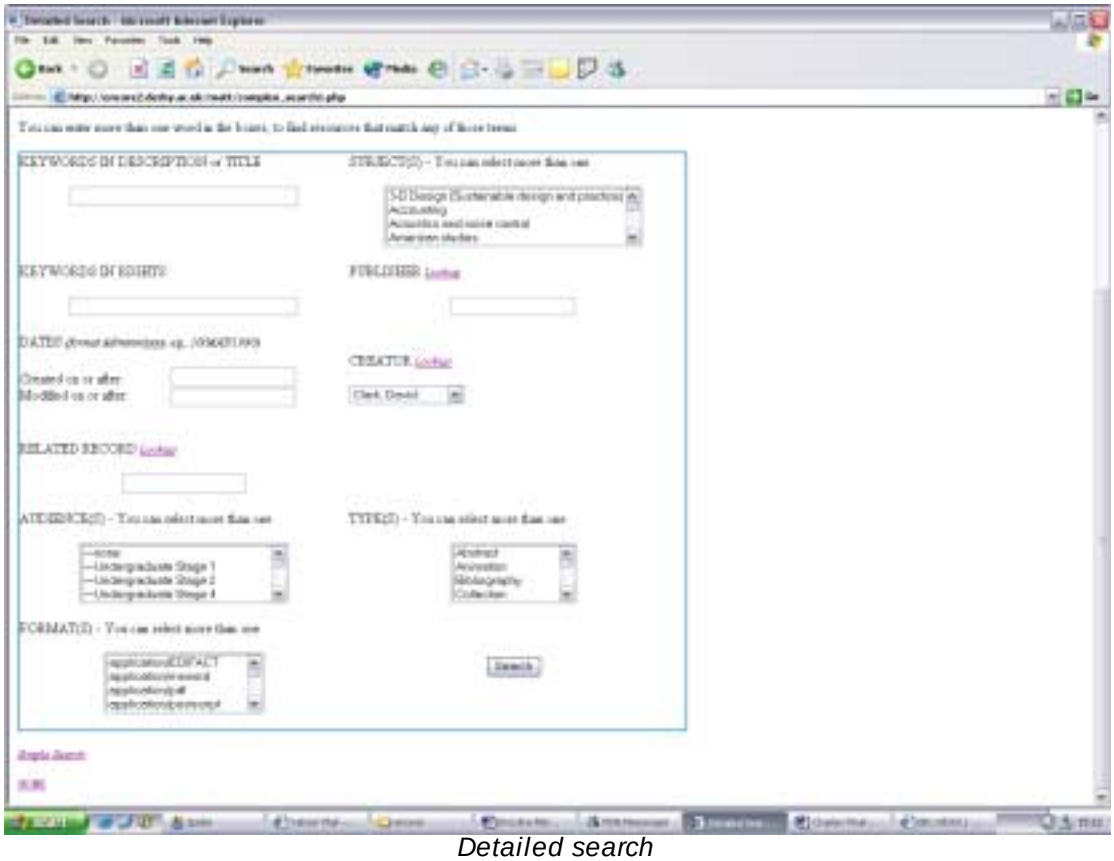
Database: screenshots



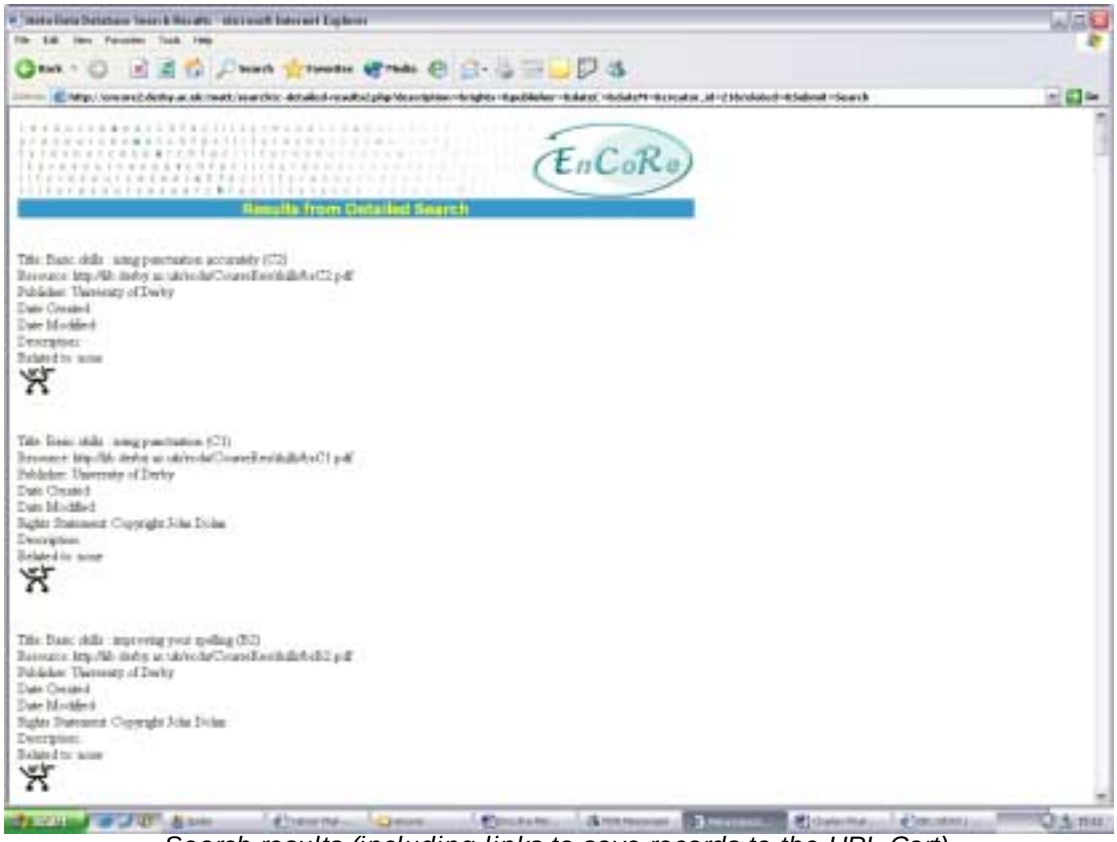
Entering meta-data



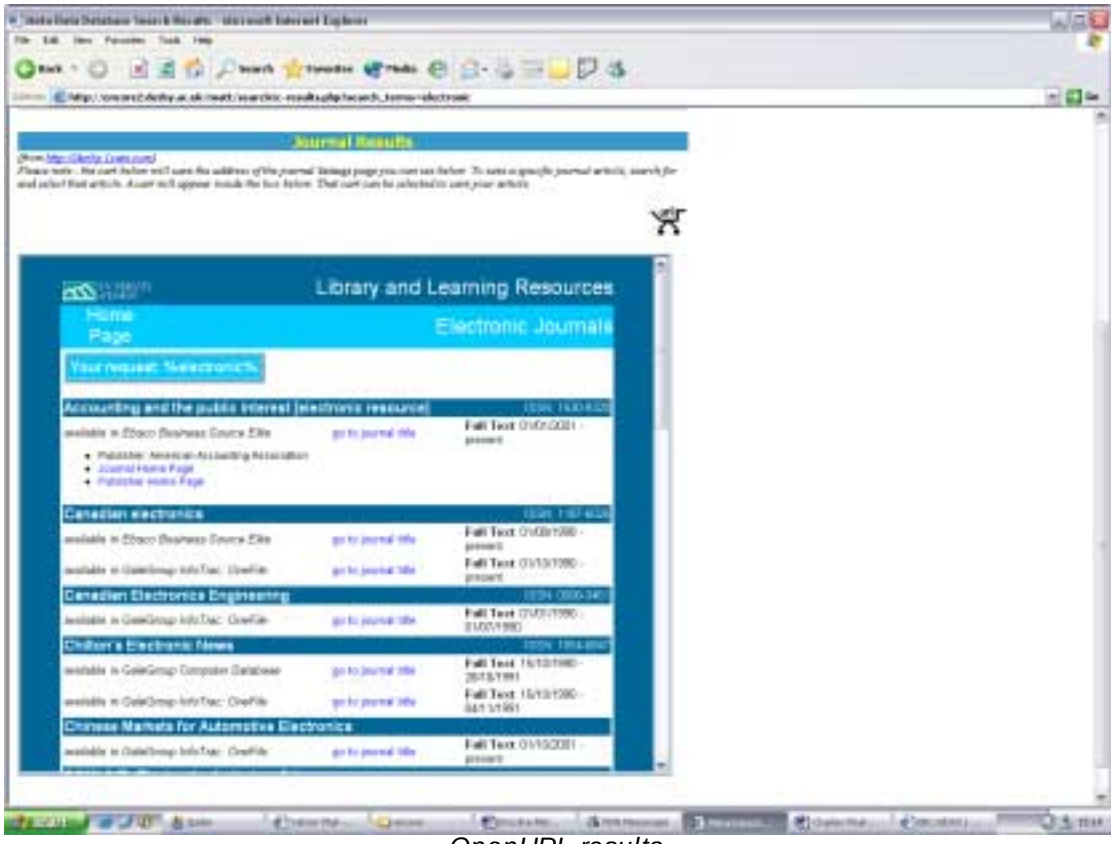
Simple search



Detailed search



Search results (including links to save records to the URL Cart)



OpenURL results

Toolkit design: concept

The concept of the 'research toolkit' as an integration mechanism between two functional systems – the digital library (resources) and the VLE (courses) was predicated on a number of concepts and assumptions:

1. that the activities implied by 'research' are common to the processes of study, coursework assessments, course planning and preparation, and academic publishing. Thus such activities provide natural linkages a) between both systems and b) between learning and teaching.
2. that such activities provide a dynamic site for quality enhancement if a mechanism to support, integrate and augment these activities can be devised: a 'toolkit'
3. using a key locus of intellectual activity (searching, browsing, reading, note-taking) as the point of integration would reduce the tangential nature of any new tools or processes and would enhance their appeal to busy academics;

The original toolkit deliverable was focussed on the academic uses of a resource: the need to annotate it, cross reference and manage linkages. At the time of the bid we were not aware of any software which could adequately perform these functions in an intuitive way; however, early in our research on annotation systems we identified the NetSnippets software (www.netsnippets.com). Several team members used the trial version, reporting back positively on its features and useability. The team then invited the company to do a presentation and discuss technical issues. From this meeting two important elements emerged: a) that a networked version is being launched and b) that customisation for EnCoRe purposes could be achieved. (Specifically, we required Harvard default formatting with options to include Number; a tool to enable cropping of an image – currently the whole image has to be saved – and on-image annotation.)

In parallel to this activity it became clear that we could go further with the toolkit as an integration mechanism between 'resources and courses', aligning it more effectively with the strategic institutional exploration of learning objects. It was therefore decided not to 'reinvent the wheel' but to use appropriate proprietary software for the annotation element and to concentrate development effort on a more significant integration tool: the Learning Object Generator.

Learning Object Generator (LOG)

The idea of linkage between the digital library and the VLE is carried through not only technically and functionally, but also educationally. Thus, with the Learning Object Generator we attempt to go beyond simply placing a resource in a course environment as a content object by adding pedagocial value to that resource. The LOG encourages a resource to be used not so much as a bibliographic item but as the basis of a learning activity. This is a shift from relatively passive reading to more active learning. In this way, we hope that courses may be genuinely 'enriched' with resources through the use of this tool.

Furthermore, by creating LOM and LD referenced metadata (see above) we achieve the potential for reusability and repurposing. This supports migration towards learning objects in line with institutional e-learning strategies.

The aim of the LOG is to enable academic staff to easily and intuitively create learning objects based on resources (e.g. an image, diagram or equation) within the digital library. In the majority of cases, the user of the system will have no experience of creating web pages or HTML but will be reasonably experienced users of a PC and the web. The system is being built to allow the user a sufficient level of control over the content and style of the produced learning object. Default settings for fonts, layout and colours will be incorporated into the system to ensure that even if the user does not wish to spend time stylising their learning object that the final product will still be of acceptable stylistic quality.

LOG: User Input

The project worked with the Radiography department to provide targeted feedback and design pointers. This proved essential. For example, the initial approach to the generator was based on 'typed' objects, an attempt to semi-structure the pedagogical approach and attach appropriate metadata at the outset. However, the feedback from Radiography suggested that tutors might find it difficult to conceptualise the activity reliably as the category boundaries were 'fuzzy' (eg comprehension/analysis) and prevented an organic thinking/planning process. We thus revised the design to one of a generic object at creation; we also focussed the design of the educational metadata in ways which we felt were hight tutor and course centred. Another feature the feedback indicated was the need for a customisable interface, giving the ojbect creator more control and a modest element of creativity. Thus, placement and formatting options are available using a toolbar concept rather than the original design of form-based input.

The second stage of user input will be the piloting of the tool with two subject groups: Radiography and English. These subjects use different pedagogical approaches and their students have different exposure to technology. This trial will run in the autum semester for six weeks, allowing us to evaluate the use and impact of resource based learning activities generated by the tool.

LOG: Access to the LOG and Distribution of Completed Objects

After final development of the Learning Object Generator has been completed it will be incorporated into UDo. Staff will be able to access the tool through UDo and save their Learning Objects to a central repository accessible from within the MLE. Unfinished objects can also be saved and returned to at a later date for completion.

Completed learning objects will be distributed through UDo where they will be directly linked to from the associated resources in the digital library and a separate search mechanism will allow users to search for Learning Objects using a range of criteria such as subject, expertise level and activity duration.

LOG: Creating a Learning Object

Within the Learning Object Generator, users create a new object and then add content to it using the wizard-like interface. When adding text for example, the user would click the 'New Text' button which would bring up a rich text entry box. This entry box has a toolbar which allows the users to:

- Add basic formatting such as bold, italic, underline
- Choose font types and sizes
- Add bullet points
- Align text to the left right or centre
- Insert hyperlinks

The buttons for each of these options are in a standard style and should therefore be familiar to users of word processing packages such as Microsoft Word. The features of this text entry box are vital to enabling the user to create suitable documents without having any knowledge of HTML.

Other elements which can be added to Learning Objects include: images, activity boxes, reading boxes, links to other relevant documents. The details of each of these are added through short entry forms which pop-up when required. Each of these forms is kept deliberately short and is designed so as not to distract the user from the process of creating educational content.

LOG: Technical Details

The technical details of the tool can be divided into 3 connected parts: the *Interface* (built in Macromedia Flash MX using ActionScript); *Server-side scripting* (Microsoft ASP 3.0); *Database* (Microsoft Access for development. Oracle 9i for deployment).

An original version of the Learning Object Generator was developed using HTML and JavaScript. From a usability perspective, it was decided that it would be advantageous for the user to be able to view the resource (around which they are building the Learning Object) in same window as the object itself. This removes any need for them to constantly switch from one window/application to another whilst in the flow of creating the new object. To achieve this, it was decided that Flash would be the preferable tool for development rather than standard HTML and JavaScript.

New functionality within Flash MX and ActionScript (Flash's scripting language) makes object-oriented programming within Flash more practical and therefore a more attractive option for building a database driven application involving relational databases.

A number of ASP scripts have been written to add new Learning Objects to the database. These scripts allow the user to add, edit or delete individual elements of a learning object.

LOG: Future Development

The future development is likely to focus on enhancing existing functionality within the generator. Currently the number of available elements is low (text, images, activities and links). This list can be added to at any time and certain possible additions have already been discussed.

For instance, it would be possible to include a multiple choice question(s) within a Learning Object. The academic would be prompted to enter the question, the correct answer and a number of incorrect answers. The system would allow the student to choose an answer and could then provide instant feedback.

Use of OpenURL in EnCoRe

We first became interested in the application of Open URL for this programme as the result of a contract we'd signed with Openly Informatics for their 1CATE OpenURL resolution service. 1CATE had caught our imagination after a demonstration and talk which Eric had given us at Derby during a visit to the UK in April 2002. It was cutting edge technology and gave us the possibilities of maximising our full text databases by linking them to our citation indexes using 1CATE's OpenURL functionality.

When the DiVLE programme was announced it seemed that there was an excellent opportunity to make use of this technology in a project bid. However, our experience and knowledge of OpenURL was limited to the 1CATE service for journals, meaning that the intended use within EnCoRe was new territory for us. The draft standard was still being drawn up by NISO and we had hoped to add to the work by extending its use to formats other than books and journal articles.

Eric Hellman, Founder and President of Openly Informatics and an expert on OpenURL accepted an invitation to be our external consultant. His input was vital to us in understanding OpenURL and our direction regarding it in the project.

When he came for a visit in December 2002, it became clear in discussion that OpenURL was not going to be a suitable vehicle for the resources we wanted to apply it to (exam papers, library guides, images and other electronic resources) nor was there any real need as such resources could be better accessed by using direct URLs since they were all located on our own servers, were specific to us, and would have little relevance to the wider community. At

the time the draft standard could only be applied to bibliographical material. It had been hoped to apply OpenURL to an existing radiology image database but after exploration with the academic responsible work was eventually halted because of time constraints.

Early on in the project, the team explored various metadata schemes for describing learning objects as elements of online course material. Learning objects became a major feature of the project and discussions took place about applying OpenURL to them. We weren't clear as to the value of trying to locate Learning Objects elsewhere in this way and our reasoning about OpenURL not being a suitable vehicle for the resources mentioned above, could also be applied here and this aspect was postponed. However as part of the toolkit we produced our own application profile for a learning object generator so we may be able to build on this work in the future especially since other projects in the DiVLE programme featured Learning Objects and OpenURL.

It had been decided to involve HERON in the project and during discussions about a HERON link in the EnCoRe toolkit, the idea of an OpenURL shopping cart was born.. The aim of the cart was to pick up OpenURLs and transport them to other documents to stand instead of a direct link to an online article. The final product was called the URL cart and it appears on the 1CATE screen when 1cate is accessed from within the MLE. It can pick up OpenURLs generated in 1CATE and also direct URLs from the EnCoRe database . The shopping cart as it is implemented here interfaces directly with a links database within the MLE and as a piece of functionality could be extended to exist in other parts of the MLE.

It was developed for EnCoRe by Eric Hellman at Openly Informatics using Java Servlets. Java Servlets were chosen as they are the technology upon which the University's MLE system is based so responsibility for the URL cart can be passed on to the MLE team once the project has run its course.

The shopping cart has further potential use in any search or location system – it can be easily modified to take links from other facilities and save them into the MLE's database or another links database.

Furthermore, as Java Servlets are a freely implementable technology, the shopping cart can be taken on by other institutions as desired.

Following another call for project bids from JISC we explored with one of our database vendors the possibility of transferring OpenURLs directly from their databases as an email option but this wasn't taken up despite the enthusiasm of the vendor's UK office. It is interesting to note that in an exchange of experience workshop two team members attended in Manchester this July, this same idea was raised by another institution. Now another OpenURL link server vendor is making the transfer of OpenURLs possible.

Developments in the future may well centre on some of the ideas we put forward for its use but currently it is too early to predict how exactly OpenURL could be usefully applied to formats other than books and journals. What we would like to see now is a DiVLE programme report drawing together all the projects' experiences of OpenURL. Most of the EnCoRe team remain in employment at Derby and would be happy to contribute to this.

Section 3: Appendices

Project website

This will be available - and updated as appropriate - until at least September 2005, at http://lib.derby.ac.uk/encore/encore.html. Should this address need to be changed, we will notify JISC of the change one month in advance.

Finance

The end-of-project financial summary will be forwarded once it has been supplied by our Finance department (by mid-October).

Staffing

The ENCoRe Team

Melanie Keady: project manager (LLR)
Charles Shields: project manager (CEDM)
Juliet Szondi: learning and teaching advisor
Matthew Keehan: web application developer
Sally Rimmer: meta data cataloguer
Paul Hill: web developer
Glenn Handley: programming, metadata and technical advisor
Ros Doig: licenses, electronic data advisor
Daniel Owen-McGee: metadata and Open URL advisor
Linda Swanson: copyright and digitisation advisor
Assad Sarwar: web developer for meta data interfaces

Eric Hellman: external partner and OpenURL consultant
David Kane: external evaluation
Pete Dalton: external evaluation

Evauation Report (CIRT)

CIRT's final report will be forwarded separately by October 7th. This report considers in depth the team structure, project management, communication, resolution of issues, and the extent to which the project achieved its initial aims.

Metadata Application Profiles

Container elements (those elements which hold other elements but do not themselves hold data directly) are in grey.
= Mandatory SCO field. This must appear and contain valid data.
* = Mandatory UK LOM Core field. This must appear and contain valid data.

1. 1. General (#) (*)
2. 1.1 General.Identifier (#) (*)
3. **1.1.1 General.Identifier.Catalog (#) (*)**
4. **1.1.2 General.Identifier.Entry (#) (*)**
5. **1.2 General.Title (#) (*)**
6. **1.3 General.Language (*)**
7. **1.4 General.Description (#) (*)**
8. **1.5 General.Keyword (#)**
9. 2 LifeCycle (#) (*)

10. 2.1 LifeCycle.Version (#)
11. 2.2 LifeCycle.Status (#)
12. 2.3 LifeCycle.Contribute (*)
13. 2.3.1 LifeCycle.Contribute.Role (*)
14. 2.3.2 LifeCycle.Contribute.Entity (*)
15. **2.3.3 LifeCycle.Contribute.Date**
16. 3 Metametadata (#) (*)
17. 3.1 Metametadata.Identifier (#) (*)
18. 3.1.1 Meta-metadata.Identifier.Catalog (#) (*)
19. 3.1.2 Meta-metadata.Identifier.Entry (#) (*)
20. 3.2 Meta-metadata.Contribute (*)
21. 3.2.1 Meta-metadata.Contribute.Role (*)
22. 3.2.2 Meta-metadata.Contribute.Entity (*)
23. 3.2.3 Meta-metadata.Contribute.Date (*)
24. 3.3 Meta-metadata.MetadataSchema (#) (*)
25. 3.4 Meta-metadata.Language (*)
26. 4 Technical (#) (*)
27. 4.1 Technical.Format (#) (*)
28. 4.2 Technical.Size
29. 4.3 Technical.Location (#) (*)
30. 5 Educational
31. 5.2 Educational.LearningResourceType
32. 5.9 Educational.TypicalLearningTime
33. 6 Rights (#) (*)
34. 6.1 Rights.Cost (#)
35. **6.2 Rights.CopyrightandOtherRestrictions (#) (*)**
36. **6.3 Rights.Description (*)**
37. 7 Relation
38. **7.1 Relation.Kind**
39. 7.2 Relation.Resource
40. 7.2.1 Relation.Resource.Identifier
41. 7.2.1.2 Relation.Resource.Identifier.Entry
42. 8 Annotation
43. 8.1 Annotation.Entity
44. 8.2 Annotation.Date
45. **8.3 Annotation.Description**
46. 9 Classification (#)
47. 9.1 Classification.Purpose (#)
48. 9.2 Classification.Taxonpath
49. 9.2.1 ClassificationTaxonpath.Source
50. 9.2.2 Classification.Taxonpath.Taxon
51. 9.2.2.2 Classification.Taxonpath.Taxon.Entry
52. 9.3 Classification.Description (#)
53. 9.4 Classification.Keyword (#)

Element mapping

Table 1 below shows the elements from the metadata schemes used and where the elements map over to one another. The mappings enable both element sets to be searched in a Dublin Core database. It can be seen that the Dublin Core Element Set has equivalents in the IEEE LOM scheme. Some qualified DC elements also map to the IEEE LOM eg Format.extent.

Table 1

DUBLIN CORE	IEEE LOM

Title	1.2 General.Title
Creator	2.3.2 LifeCycle.Contribute.Entity if Contribute.Role = author
Subject	1.5 General.Keyword 9.1 Classification.Purpose if = discipline or idea
Description	1.4 Description *
Publisher	2.3.2 LifeCycle.Contribute.Entity if Contribute.Role = publisher
Contributor	2.3.2 LifeCycle.Contribute.Entity (with role specified in Contribute.Role)
Date	2.3.3 Date when role = publisher
Type	5.2 LearningResourceType
Format	4.1 Technical.Format
Format.Extent	4.2 Technical.Size 4.7 Technical.Duration
Identifier	1.1.2 General.Identifier.Entry 4.3 Technical.Location
Source	7.2 Relation.Resource if Relation.Kind = isBasedOn
Language	1.3 General.Language
Relation	7.2.2 Relation.Resource.Description
Coverage	1.6 General.Coverage
Rights	6.3 Rights.Description
Audience.educationlevel	5.6 Educational.Context 9.1 Classification.Purpose if = education level

Further details on the profiles can be found on the EnCoRe website and in the definitive University of Derby Metadata Application Profile document, a bound copy of which will be submitted along with bound copies of this report and of CIRT's evaluation report.

Database

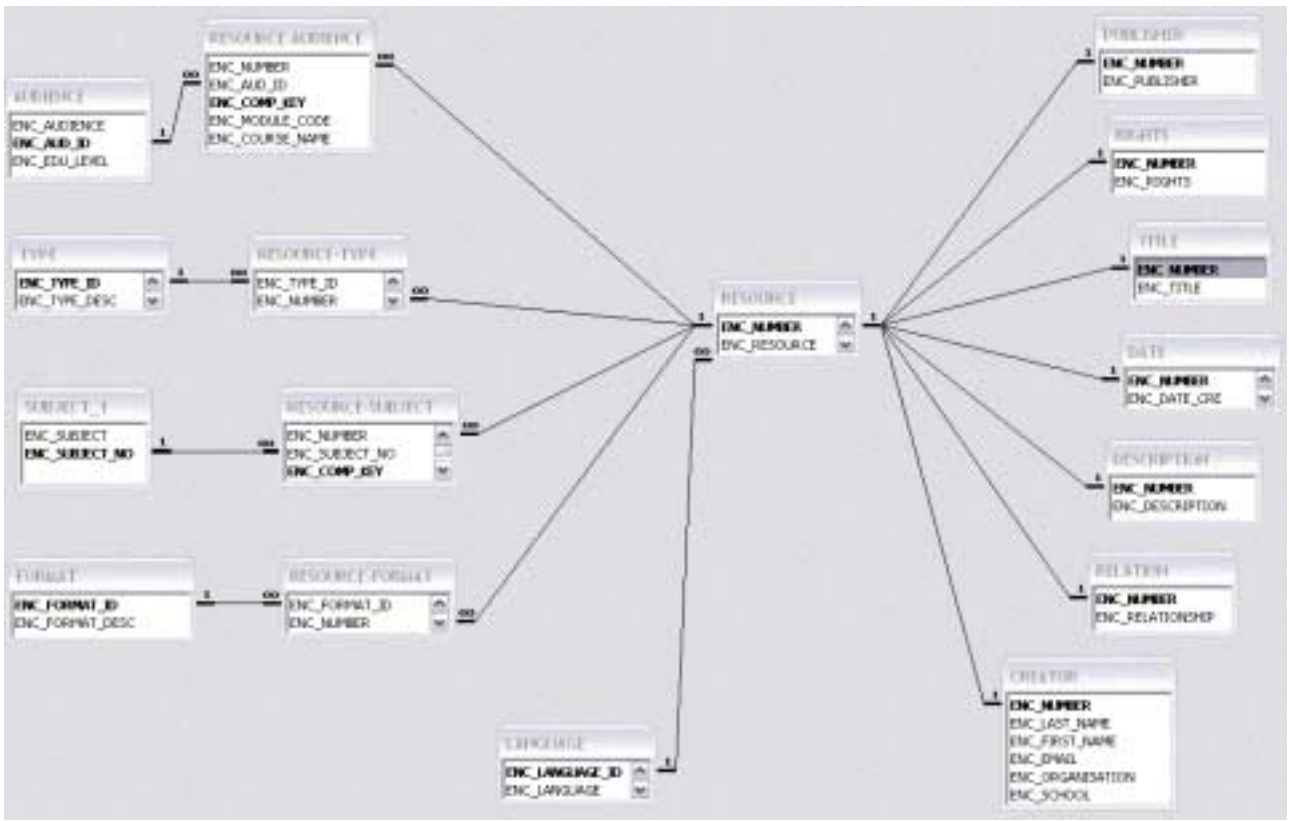


Table 2: EnCoRe DB Entity Relationship Diagram generated by Access

Database tables

Resource

ENC_NUMBER	Autonumber	simple ID	PK
ENC_RESOURCE	String	URL/Resource-Identifier	

Title

ENC_NUMBER	number	simple ID	PK
ENC_TITLE	String	title	

Creator

ENC_NUMBER	number	simple ID	PK
ENC_LAST_NAME	string		
ENC_FIRST_NAME	string		
ENC_EMAIL	string		

Resource-Subject

ENC_NUMBER	number	simple ID	FK
ENC_SUBJECT_NO	string (period-delimited-number)		FK
ENC_COMP_KEY	compact key of above keys		PK

Subject

ENC_SUBJECT	string	the subject name	
ENC_SUBJECT_NO	string (period-delimited-number)		PK

Relation

ENC_NUMBER	number	simple ID	PK
ENC_RELATIONSHIP	number	ENC_NUMBER of the referenced resource	

Rights

ENC_NUMBER	number	simple ID	PK
ENC_RIGHTS	string (long)	description of rights	

Description

ENC_NUMBER	number	simple ID	PK
ENC_DESCRIPTION	string (long)	description of the resource	

Publisher

ENC_NUMBER	number	simple ID	PK
ENC_PUBLISHER	string	name of publisher – default University of Derby	

Resource-Audience

ENC_NUMBER	number	simple ID	FK
ENC_AUD_ID	number	audience identifier	FK
ENC_COMP_KEY	compact key of above keys		PK

Audience

ENC_AUDIENCE	string	description of audience	
ENC_AUD_ID	number	audience identifier	PK

Date

ENC_NUMBER	number	simple ID	PK
ENC_DATE_CREATED	date		
ENC_DATE_LAST_MOD	date	date last modified	

Resource-Type

ENC_TYPE_ID	number	type identifier	FK
ENC_NUMBER	number	simple ID	FK
ENC_COMP_KEY	compact key of above keys		PK

Type

ENC_TYPE_ID	auto-number	type identifier	PK
ENC_TYPE_DESC	string	description of the type	

Resource-Format

ENC_FORMAT_ID	number	format identifier	FK
ENC_NUMBER	number	simple ID	FK
ENC_COMP_KEY	compact key of above keys		PK

Format

ENC_FORMAT_ID	auto-number	format identifier	PK
ENC_FORMAT_DESC	string	the format	

Language

ENC_NUMBER	number	simple ID	FK
ENC_LANGUAGE	string		

SQL code for DB

ENC_Resource

Note: RESOURCE is an Oracle reserved word.

ENC_RESOURCE_ID	Autonumber	simple ID	PK
ENC_RESOURCE	String	URL/Resource-Identifier	

```
create table ENC_RESOURCE (
ENC_RESOURCE_ID integer not null,
ENC_RESOURCE varchar2(255),
```

```
constraint ENC_RESOURCE_ID_PK primary key (ENC_RESOURCE_ID)
);
```

ENC_Title

ENC_TITLE_ID	number	simple ID	PK
ENC_TITLE	String	title	

```
create table ENC_TITLE (
ENC_TITLE_ID integer not null,
ENC_TITLE varchar2(255),
constraint ENC_TITLE_ID_PK primary key (ENC_TITLE_ID)
);
```

ENC_Creator

ENC_CREATOR_ID	number	simple ID	PK
ENC_LAST_NAME	string		
ENC_FIRST_NAME	string		
ENC_EMAIL	string		

```
create table ENC_CREATOR (
ENC_CREATOR_ID integer not null,
ENC_LAST_NAME varchar2(255),
ENC_FIRST_NAME varchar2(255),
ENC_EMAIL varchar2(255),
constraint ENC_CREATOR_ID_PK primary key (ENC_CREATOR_ID)
);
```

ENC_Resource_Subject

ENC_RESOURCE_ID	number	simple ID	FK
ENC_SUBJECT_ID	number		FK

```
create table ENC_RESOURCE_SUBJECT (
ENC_RESOURCE_ID integer not null,
ENC_SUBJECT_ID integer not null,
foreign key (ENC_RESOURCE_ID) references ENC_RESOURCE(ENC_RESOURCE_ID),
foreign key (ENC_SUBJECT_ID) references ENC_SUBJECT(ENC_SUBJECT_ID)
);
```

ENC_Subject

ENC_SUBJECT_ID	number		PK
ENC_SUBJECT	string	the subject name	

```
create table ENC_SUBJECT (
ENC_SUBJECT_ID integer not null,
ENC_SUBJECT varchar2(4000),
ENC_SUBJECT_NO varchar2(255),
constraint ENC_SUBJECT_ID_PK primary key (ENC_SUBJECT_ID)
);
```

ENC_Relation

ENC_RELATION_ID	number	simple ID	PK
ENC_RELATIONSHIP	number	ENC_NUMBER of the referenced resource	

```
create table ENC_RELATION (
ENC_RELATION_ID integer not null,
ENC_RELATIONSHIP integer not null,
constraint ENC_RELATION_ID_PK primary key (ENC_RELATION_ID)
);
```

ENC_Rights

ENC_RIGHTS_ID	number	simple ID	PK
ENC_RIGHTS	string (long)	description of rights	

```
create table ENC_RIGHTS (
ENC_RIGHTS_ID integer not null,
ENC_RIGHTS varchar2(4000),
constraint ENC_RIGHTS_ID_PK primary key (ENC_RIGHTS_ID)
);
```

ENC_Description

ENC_DESCRIPTION_ID	number	simple ID	PK
ENC_DESCRIPTION	string (long)	description of the resource	

```
create table ENC_DESCRIPTION (
ENC_DESCRIPTION_ID integer not null,
ENC_DESCRIPTION varchar2(4000),
constraint ENC_DESCRIPTION_ID_PK primary key (ENC_DESCRIPTION_ID)
);
```

ENC_Publisher

ENC_PUBLISHER_ID	number	simple ID	PK
ENC_PUBLISHER	string	name of publisher – default University of Derby	

```
create table ENC_PUBLISHER (
ENC_PUBLISHER_ID integer not null,
ENC_PUBLISHER varchar2(255),
constraint ENC_PUBLISHER_ID_PK primary key (ENC_PUBLISHER_ID)
);
```

ENC_Resource_Audience

ENC_RESOURCE_ID	number	simple ID	FK
ENC_AUDIENCE_ID	number	audience identifier	FK

```
create table ENC_RESOURCE_AUDIENCE (
ENC_RESOURCE_ID integer not null,
ENC_AUDIENCE_ID integer not null,
foreign key (ENC_RESOURCE_ID) references ENC_RESOURCE(ENC_RESOURCE_ID),
foreign key (ENC_AUDIENCE_ID) references ENC_AUDIENCE(ENC_AUDIENCE_ID)
);
```

ENC_Audience

ENC_AUDIENCE_ID	number	audience identifier	PK
ENC_AUDIENCE	string	description of audience	

```
create table ENC_AUDIENCE (
ENC_AUDIENCE_ID integer not null,
ENC_AUDIENCE varchar2(4000),
constraint ENC_AUDIENCE_ID_PK primary key (ENC_AUDIENCE_ID)
);
```

ENC_Date

ENC_DATE_ID	number	simple ID	PK
ENC_DATE_CREATED	date		
ENC_DATE_LAST_MOD	date	date last modified	

```
create table ENC_DATE (
ENC_DATE_ID integer not null,
ENC_DATE_CREATED date,
ENC_DATE_LAST_MOD date,
constraint ENC_DATE_ID_PK primary key (ENC_DATE_ID)
);
```

ENC_Resource_Type

ENC_TYPE_ID	number	type identifier	FK
ENC_RESOURCE_ID	number	simple ID	FK

```
create table ENC_RESOURCE_TYPE (
ENC_TYPE_ID integer not null,
ENC_RESOURCE_ID integer not null,
foreign key (ENC_TYPE_ID) references ENC_TYPE(ENC_TYPE_ID),
foreign key (ENC_RESOURCE_ID) references ENC_RESOURCE(ENC_RESOURCE_ID)
);
```

ENC_Type

ENC_TYPE_ID	auto-number	type identifier	PK
ENC_TYPE_DESC	string	description of the type	

```
create table ENC_TYPE (
ENC_TYPE_ID integer not null,
ENC_TYPE_DESC varchar2(4000),
constraint ENC_TYPE_ID_PK primary key (ENC_TYPE_ID)
);
```

ENC_Resource-Format

ENC_RESOURCE_ID	number	simple ID	FK
ENC_FORMAT_ID	number	format identifier	FK

```
create table ENC_RESOURCE_FORMAT (
ENC_RESOURCE_ID integer not null,
ENC_FORMAT_ID integer not null,
foreign key  (ENC_RESOURCE_ID) references ENC_RESOURCE(ENC_RESOURCE_ID),
foreign key (ENC_FORMAT_ID) references ENC_FORMAT(ENC_FORMAT_ID)
);
```

ENC_Format

ENC_FORMAT_ID	auto-number	format identifier	PK
ENC_FORMAT_DESC	string	the format	

```
create table ENC_FORMAT (
ENC_FORMAT_ID integer not null,
ENC_FORMAT_DESC varchar2(4000),
constraint ENC_FORMAT_ID_PK primary key (ENC_FORMAT_ID)
);
```

ENC_Language

ENC_LANGUAGE_ID	number	simple ID	FK
ENC_LANGUAGE	string		

```
create table ENC_LANGUAGE (
ENC_LANGUAGE_ID integer not null,
ENC_LANGUAGE varchar2(4000),
constraint ENC_LANGUAGE_ID_PK primary key (ENC_LANGUAGE_ID)
);
```

Sequences and Triggers

Sequence and trigger for primary key on **resource**

```
create sequence seq_enc_rsc_key;

create trigger tri_enc_rsc_key
before insert on ENC_RESOURCE
for each row
begin
        select seq_enc_rsc_key.nextval into :new.enc_resource_id from
dual;
end;
/
```

Sequence and trigger for primary key on **audience**

```
create sequence seq_enc_aud_key;

create trigger tri_enc_aud_key
before insert on ENC_AUDIENCE
for each row
begin
        select seq_enc_aud_key.nextval into :new.enc_audience_id from
dual;
end;
/


create sequence seq_enc_sub_key;

create trigger tri_enc_sub_key
before insert on ENC_SUBJECT
for each row
begin
        select seq_enc_sub_key.nextval into :new.enc_subject_id from
dual;
end;
/
```

Sequence and trigger for primary key on **type**

```
create sequence seq_enc_typ_key;

create trigger tri_enc_typ_key
before insert on ENC_TYPE
for each row
begin
        select seq_enc_typ_key.nextval into :new.enc_type_id from
dual;
end;
/
```

Sequence and trigger for primary key on **format**

```
create sequence seq_enc_frm_key;

create trigger tri_enc_frm_key
before insert on ENC_FORMAT
for each row
begin
        select seq_enc_frm_key.nextval into :new.enc_format_id from
dual;
end;
/
```

Sequence and trigger for primary key on **language**

```
create sequence seq_enc_lng_key;

create trigger tri_enc_lng_key
before insert on ENC_LANGUAGE
for each row
begin
        select seq_enc_lng_key.nextval into :new.enc_language_id from
dual;
end;
/
```