TERTIARY ACCORD OF NEW ZEALAND

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Report on Guidelines for the Development of Standards for Digital Learning Objects Repository related to the eCDF Project 124

"Delivering Applied e-Learning in the Workplace: Polytechnics and ITOs Working Together"

Compiled for the Tertiary Accord of New Zealand (TANZ)

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CHRISTCHURCH POLYTECHNIC INSTITUTE OF TECHNOLOGY Te Wānanga o Ōtautahi

Report on Guidelines and Standards for TANZ Digital Learning Object Repository

1. Foreword

This document was completed in October 2004 and needs to be viewed as a work in progress. It should also be noted that this report differs from the original intention of the application to the ECDF in that it is neither a comprehensive review of all standards and protocols relating to learning object repositories nor did it seek to develop related “criteria, protocols and standards”. A shift in focus occurred for some of the following reasons:

1. A large number of standards have been developed in this area internationally; many within specific geographical regions to suit particular system architectures. There has been rapid development in this area recently with an increasing emphasis on modular approaches to systems and system interoperability. It remains to be seen which of the older eLearning standards will remain relevant alongside the ubiquitous xml and web service protocols.
2. Learning object repositories have not been well explored in New Zealand therefore there are few established standards (Dublin Core as a metadata standard is well established and is a notable exception). As late adopters the New Zealand education sector can take advantage of the new era of information architecture which has grown out of the development of open system architecture (this is discussed further in section1.2 of this foreword).
3. The emerging Service Oriented Approach (SOA) is most clearly represented by CETIS’s ELearning Framework. This has been one the key frameworks that has informed the Ministry of Educations eLearning framework and Education Sector Architecture Framework (ESAF) its technical infrastructure. It is through the development of these frameworks with particular emphasis on practitioner involvement and consultation that standards and protocols appropriate to the New Zealand environment will emerge.

1.1 Interoperability and Standardisation

Interoperability has been a catch cry for the last few years and has been accompanied by the push for **standardisation**. The great early success in this area was the development of the World Wide Web by the global acceptance of the http protocol. Many of our clients have been brought up on using this seamless internet environment where resources with vastly different origins are provided in a common environment, integrated by hyperlinks.

However, when they enroll in our educational institutions they are confronted with a number of different environments to serve their different needs, each requiring the user to identify themselves. A significant aim of interoperability in the context of educational institutions is to bring these services together in a seamless, coherent and convenient way for our users. Clearly the most effective way of achieving this is through the standardisation of technology.

There are also significant financial benefits for institutions including the future proofing of investments in technology, the reduction of duplication of IT development between departments and a corresponding saving in staffing resources.

1.2 System Architecture

Many papers written as recently as a year ago continued to refer to architectures with complex structures. However within the last year as technology has evolved (particularly with regard to the uptake of XML, web services and related technology) it was becoming clear that the whole idea of system architecture was being reassessed. More recently there has been a "conceptual shift away from traditional systems architecture" towards flexible frameworks defined by services. (McLean and Lynch, 2004, p14)

This is where Service Oriented Architecture or **Service Oriented Approach** has emerged. Each service exists as an independent "block" or chunk, it complies with an established standard relevant to the provision of that service, for example it employs standardised metadata and established protocols. The key commonality to each block is that data is "bound" in xml.

Web Services is the group of technologies that have been developing to transport the data from one chunk to another and also for querying xml data and creating a service. For example in the provision of a group of services data might be taken from a number of different applications and reformatted in a space personalized by the user. So what you are left with is a conceptual model of service chunks "loosely coupled" (eg can be easily linked and unlinked) to create flexible frameworks or networks.

This can be hugely challenging for institutions. It requires breaking down the traditional idea of service provision through independent enterprise solutions towards the sharing of common services between service areas. Many feel threatened by the idea that they may need to decommission their proprietary enterprise systems that took many years and much money to develop. This is not necessarily the case; it might be a matter of dismantling and rebuilding some of the components or using middleware applications to links services.

One of the best current examples of a Service Oriented Approach in the eLearning area is the CETIS's ELearning Framework, this has been hugely influential in the area of systems architecture in tertiary eLearning including in New Zealand through the Ministry of Education's ELearning Framework.

1.3 Repositories

There has also been a lot of confusion about what exactly a "learning object repository" is. There have been independent discussions about learning object repositories, institutional repositories, peer to peer repositories, digital repositories and so on.
It is becoming increasingly clear that repositories are just a concept that refers to a set of services and functions. There are search and retrieve services, storage of objects on a variety of "devices", metadata storage and retrieval, authentication services (shared between applications), rights management functions and services. It is crucial that there is institutional wide agreement and understanding on what these services and functions are to be.

1.4 White Papers

In the middle of last year there were a number of key white papers which have been instrumental in bringing thinking forward in this area, most notably in pulling together some of the parallel developments within the eLearning and information environments.

Blinco, K., Mason, J., McLean, N., and Wilson, S. (2004). Trends and issues in e-learning infrastructure development. A white paper for alt-i-lab 2004. Prepared on behalf of DEST (Australia) and JISC-CETIS (UK). Retrieved January 14 2005, from http://www.jisc.ac.uk/uploaded_documents/Altilab04-repositories.pdf

Campbell, L. M., Blinco, K., and Mason, J. (2004). Repository management and implementation. A white paper for alt-i-lab 2004. Prepared on behalf of DEST (Australia) and JISC-CETIS (UK). Retrieved January 14 2005, from http://www.jisc.ac.uk/uploaded_documents/Altilab04-repositories.pdf

McLean, N,. and Lynch, C,. (2004). Interoperability between library information services and learning environments – bridging the gaps. Retrieved December 5, 2004 from http://www.imsglobal.org/digitalrepositories/CNIandIMS_2004.pdf

Wilson, S., Blinco, K., and Rehak, D., (2004). Service-Oriented frameworks: modelling the infrastructure for the next generation of e-learning systems. A paper prepared on behalf of DEST (Australia), JISC-CETIS (UK), and Industry Canada. Retrieved January 14 2005, from http://www.jisc.ac.uk/uploaded_documents/Altilab04-repositories.pdf

2.0 Executive Summary

2.1 Document purpose

The purpose of this document is to seek feedback and to provide a starting point for the discussion around learning object repositories and to introduce issues for further investigation and recommendations for discussion. The document seeks to cover:

- The overall guiding principles
- Use case scenarios
- Relevant standards, protocols and technologies.
- Recommendations for discussion.

2.2 Vision

The broad objectives of a repository of learning objects to be shared by the TANZ partners can be defined by the following concepts:
Find: the discovery of learning objects and learning material through a repository.
Get: the ability to retrieve objects and learning material, this might be done instantly or through a series of transactions.
Contribute: the ability for TANZ members to contribute resources to the repository as conveniently as possible.
Annotate: the ability to add annotations to the metadata to inform the community of how particular learning objects have been used.

2.3 Recommendations and actions

1. Seek consensus on the 10 guiding principles outlined in section 3.
   1. Adopt open standards and protocols.
   2. Seek local consensus on the application of standards.
   3. Implement open systems.
   4. Use open source applications where possible.
   5. Apply metadata standards.
   6. Take a modular approach to metadata.
   7. Use controlled vocabularies.
   8. Use simple digital rights.
   9. Provide an open market place.
   10. Contribute to the semantic web.

2. Create a TANZ metadata application profile ensuring interoperability with National Library of New Zealand' Metadata Standards Framework and ESAF's Education Sector Metadata Schema.
3. Further investigate the requirements of Digital Rights Management within the TANZ environment.

3. Introduction

The benefits of a repository of learning objects to be shared by the TANZ partners include:

- The **reduction of costs** through the reuse of online learning materials.
- **Increased quality** through peer review and collaboration.
- An exponential increase in the availability of **high quality online learning materials.**

There are significant challenges facing institutions implementing systems in a rapidly changing technological environment. The concepts of learning objects learning object repositories and metadata are constantly debated and are not consistently applied within the online education and information spaces. As a broad concept learning object repositories present an opportunity for collaboration and interoperability between libraries, ICT and e-learning communities.

The National Digital Strategy provides a useful framework for collaborating and for addressing the issues particularly the three C's of content, capability, connection and continuity the fourth C recommended by the Library and Information Association of New Zealand Aotearoa (LIANZA).

Content:

- Increasing the availability and reusability of online learning resources and objects.
- Freeing content from proprietary systems, making it discoverable on the web.

Capability:

- Increasing the capabilities of the participants in the library, ICT and education spaces allowing collaboration based on shared technologies.
- The shift from educational institutions as consumers of proprietary systems to developers and implementers of open systems (and open source) requires the building of technical capabilities; this is particularly the case within libraries.

Connection:

- Enabling interoperability between information and education systems, creating shared services, connecting people and resources in a common environment.
- Taking modular approach to system architecture, connecting applications together using common technologies.

Continuity:

- Ensuring that existing systems will evolve and that quality will constantly improve.

- Ensuring that technologies, standards and frameworks are future proof and that products can be continually used in the future.

4. Guiding principles

1. The adoption of **open standards and protocols** to (including for the description and exchange of data):
    - Prevent content becoming “locked in” to proprietary systems.
    - To ensure educational content can be reused.
    - To ensure educational content and learner information can be shared.
    - To facilitate interoperability.

2. The seeking of **local consensus** on the adoption of standards to:
    - Enable resource sharing between organisations.
    - Ensure the same standards are applied consistently.

3. Investment in **open systems** e.g. open component based architecture employing xml and related technologies to:
    - Enable the easy addition of new components and services e.g. building block or Lego analogy.
    - Ensure the efficient use of resources by sharing common services e.g. One database of client data shared by repository and learning management system.
    - Reduce entry barriers to new partners e.g. open systems can easily interact with other open systems.
    - Allow for the growth in collaborative opportunities e.g. TANZ learning object repository vs. education sector learning object repository.

4. Use of **open source** applications where possible to:
    - Provide sustainability.
    - Lower adoption barriers and risks to institutions.
    - Provide the flexibility to modify to meet new needs.

5. The application of internationally established but locally defined **metadata** standards to ensure:
    - interoperability
    - global discovery
    - but also allowing multiple metadata description and standards tolerance.

6. Take a modular approach to metadata.
    - Adopt Dublin Core as a base standard schema for resource discovery.

- Extend the base schema using other standard schema to satisfy the needs of TANZ objects management. Eg ODRL for Digital rights Management, DCEducation for education elements.

7. Use of established and authoritative **controlled vocabularies** to:

- increase interoperability
- increase functionality provided to end users searching and retrieving learning objects.

8. **Simple digital rights management**. Where possible the acquisition of rights and the exchange of funds will be automated to:

- Ensure that it is easier to buy material than to pirate it.
- Reduce transaction costs for the purchasers of learning materials

Multiple Digital Rights statements will be provided for free, shared, and commercial materials.

9. **An open Marketplace**. The repository will accommodate:

- free content distribution
- co-operative or shared content distribution
- and fee-based content distribution.

10. Contribute to the **semantic web**. Repository metadata will be part of the visible "surface web" to enable the widest possible reach. Eg metadata will be retrieved via a Google search.

5. Use case scenarios

5.1 A TANZ learning object repository contains the collective e-learning output of the TANZ institutions.

A generic Learning Object Repository (LOR) can be seen as having the following three general layers, a search interface, metadata, and storage of the learning objects.
1. Search interface: A LOR can allow registered or unregistered users access to search and retrieve learning objects from the repository. A LOR can typically provide simple and advanced queries, as well as browsing through the material by subject or discipline. In a simple query, keywords given by the user are matched against the text in a number of the metadata elements. An advanced query allows a user to specify values for specific metadata elements, by using pull down menus, tick boxes etc. Terms are made available by a controlled vocabulary (or thesaurus) as part of the appropriate metadata element. (For examples of advanced searches and controlled vocabulary refer Appendix B)

Browsing typically allows the user to descend in a tree of disciplines and sub-disciplines to get an impression of the objects available in different domains.

2. Metadata or data about data can capture characteristics of the learning objects as well as their potential educational application.

3. A LOR can access both the learning object and their metadata; this can be achieved in an actual sense by storing them on the same server or in a virtual sense with the repository pulling together different combinations of distributed objects and data. Standards based open systems allow for many combinations of distributed architectures that slot together like Lego.

Factors that will determine the most suitable architecture for a TANZ learning object repository might be:

- The level of e-learning activity at each organisation including the production of learning objects and other learning material.
- The IT infrastructure of each organisation including server capabilities.
- The level of resident metadata expertise.
- The relationship between the e-learning and library activities.

5. 2 Before a new learning object is created a search is carried out to determine whether a suitable object already exists that can be reused

The content designer will be able to carry out a simple keyword search or will be able to narrow their search by a number of criteria provided by pull down menus, for example they could search for a learning object that has been designed to be used with a particular NZQA registered course or involving a particular learning style.

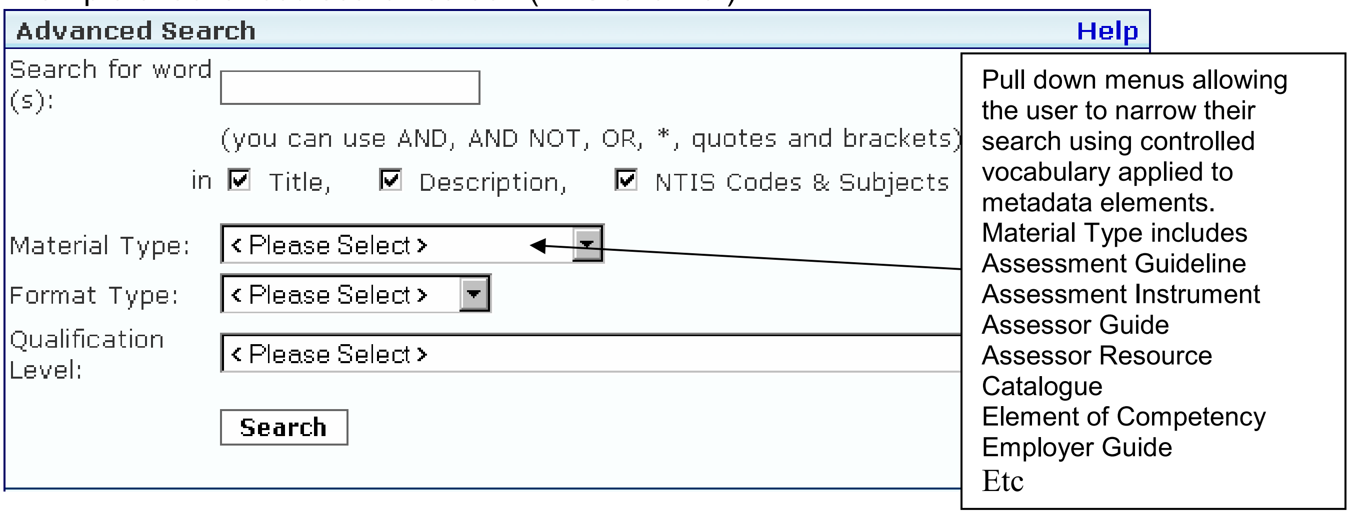
The successful search and retrieval of relevant objects though a keyword search requires the consistent application of metadata (data that describes data) to objects in the repository. Metadata standards have been developed to ensure that this data can be exchanged between applications. The two main standards in this area are the Dublin Core element set for describing any digital resource and IEEE Learning Object Metadata (IEEE LOM) which is applied specifically to learning material.

To be able to provide lists of values for searchers to narrow their search is carried out by applying controlled vocabularies to some of the metadata fields. The most suitable controlled vocabulary to use in any given situation is the most established and authoritative available. For example if a user wished to search by subject the most appropriate controlled vocabulary would be NZQA subjects, similarly NZQA course codes would not only provide a useful piece of contextual information for the application of the object but also provide a convenient entry point for searching.

The learning object repository will be accessed by the designer conveniently from within their workspace for example from within a Learning Management system.

This will require interoperability between the repository and other systems.

Example of advanced search screen (AEShare Net)



5.3 The content/course designer will be presented with a full description of the learning object, enough information (metadata) will be provided for the designer to make a decision about the suitability of an object without actually needing to view it.

As well as fixed data that describes the object, there will be information provided by users of the object describing the educational context in which it has been used. There may also be a rating system that has been provided as part of a peer review process.

It's important to provide the right balance between giving enough information to the user to identify a useful object and not making the cataloguing process too inconvenient for the person depositing the object into the repository. Consensus needs to be reached within the user community about the core data elements that are required to make a record useful and within the constraints of established standards.

The process of mixing and matching existing metadata standards to create a complete metadata schema to serve the needs of a particular community is the creation of an application profile.

5.4 The designer has chosen a learning object that they would like to reuse. This may involve simply re purposing the object without modifying it or adapting it to create a new learning object.

The reuse of learning objects presents a number of administrative challenges:
1. Digital rights management: Digital rights determine who can do what with digital material and under which conditions.
2. Version control: This keeps a track of the lifecycle of the object, including who has modified it and how.
3. Technical metadata: This records information about the technical attributes of an object and the technology that is required to view/play it.

5.5 A content designer has created a new learning object (or re-purpose an existing learning object). They will now submit it to the learning object repository.

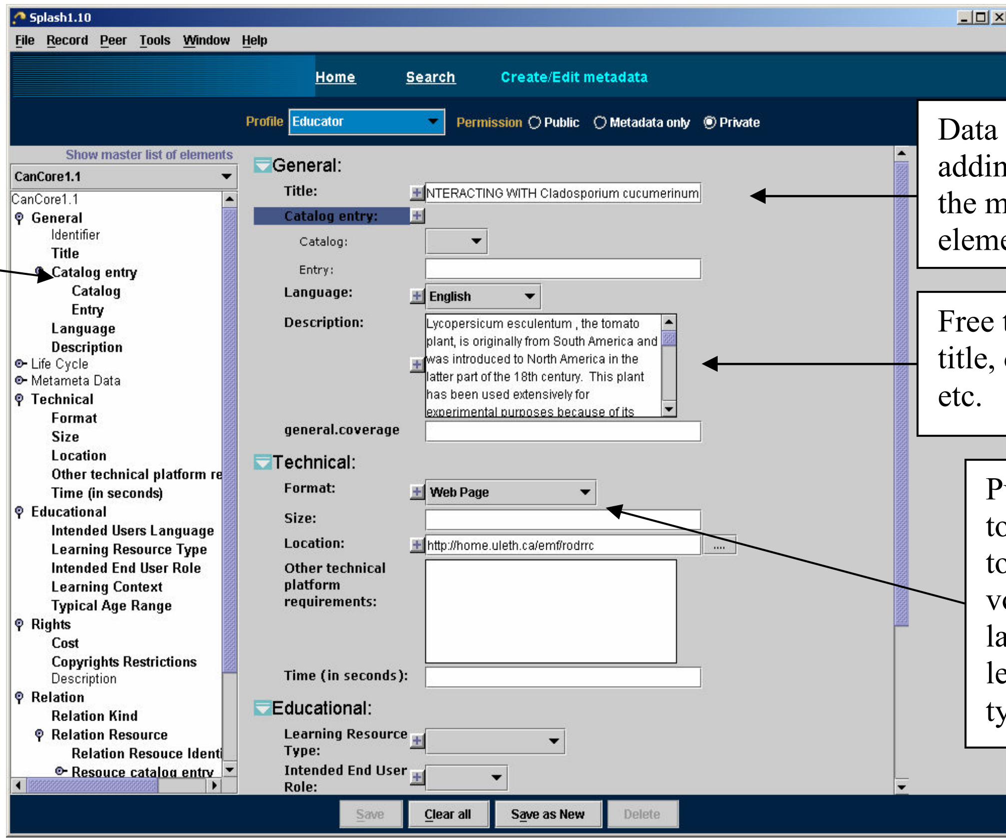
The designer will access a web form (or metadata editor), they will be required to enter some mandatory information that describes the object. Some of these will be via a free text box such as for the title of the object and a brief description. Where possible most other mandatory information will be provided from lists of vocabulary (controlled vocabulary) provided by pull down menus. This is to ensure that descriptions are assigned to objects consistently; this will greatly enhance the ability to search for it later.

The debate about the creation and assigning of metadata focuses on the issues of quality control, subject vs metadata expertise, and workflows. Three potential models:

- Catalogued by creator. High level of subject knowledge, low level of metadata knowledge. This can seriously jeopardise consistency, purity of data, and therefore searchablity of repository.
- Collaboration between creator and library. Creator provides mandatory metadata, completed by collection manager. Institutional repository model DSpace. Creator drops partially catalogued object into system, picked up and completed by cataloguer.
- Catalogued by library. Low level of subject knowledge, high level of metadata knowledge. Issues of how you collect appropriate metadata at point learning object is created?

Example of a metadata editor

Metadata elements. CanCore an Application Profile (or local application) of IEEE LOM.



Data entry forms for adding metadata to the metadata elements.

Free text boxes for title, description etc.

Pull down menus to provide access to the controlled vocabularies eg language, format, learning resource type.

5.6 The metadata describing the object in the repository is made available on the World Wide Web.

The potential user might carry out a Google search which retrieves the metadata taking them to the repository web interface or they may have found their way directly to the TANZ webpage or they may have harvested the TANZ metadata from another e-learning search interface such as a learning object browser or from within their learning management system. They may be able to retrieve a full description of the learning object and carry out another search.

5.7 If they are an authorised user they may log in and retrieve the object, a commercial transaction may take place or they may be encouraged to make contact with the person responsible for the resource.

The digital rights management system will determine whether the user is able to use the resource in the way that they intend. This may be as simple as a general expression of terms of access and use or it may involve the enforcement of those terms through technology for example file protection and encoding.

6. Discussion of key concepts, standards, protocols and technologies

6.1 Learning objects

There is some debate around the definition of learning objects.

"modular digital resources, uniquely identified and met tagged, that can be used to support learning." National Learning Infrastructure Initiative.

"any digital resource that can be reused to support learning" David A. Wiley, "Connecting Learning Objects to Instructional Design Theory"

"[A]ny entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning" Learning Object Metadata Working Group of the IEEE Learning Technology Standards Committee (LTSC)

From an information management perspective the differences between "learning objects" and other digital and information objects can be overstated. It is how we describe the common elements between say a simple digital image and an interactive java script that will allow them to coexist in a common environment.

In this sense a learning object is essentially no different from any other digital object. The only difference being that you require more metadata elements to describe it. The challenge is to provide a metadata structure that acknowledges this commonality between all digital things but also allows the flexibility to describe diverse objects.

6.2 Interoperability

Interoperability is the concept that independently developed software components can exchange information so that they can be used together. Ultimately the goal is to provide coherent services for users from components that may be technically different and originating from different applications and platforms.

This can be achieved through standardisation: Standardise what is being exchanged, how to structure it for exchange and how to exchange it.

6.3 XML

- Extensible Mark-up Language
- Specification defined by the World Wide Web Consortium (W3c) in 1998.
- A cross platform software and hardware independent approach to create, search, store, and share meaningful information.

- 3 major components
  - XML – Contains tags and data
  - DTD – Document Type Definition describes data.
  - XSL – Extensible style sheet Language for presentation of data.

- The employment of XML and its related technologies is a key feature that Open Systems have in common.
- Facilitates interoperability as it is a widely implemented international data standard.
- An important component in the concept of the semantic web.

6.4 Search and retrieval protocols

Protocols for searching distributed databases and for retrieving metadata:

Search and Retrieve Web Service (SRW)

- Also known as ZING-Z3950 in the Next Generation
- An XML-based protocol for searching, retrieving, and other information retrieval transactions
- Brings the concepts and experience of Z39.50 into the web environment using the standards/technologies for web services
  XML – to encode data
  SOAP (Simple object access protocol) – for interaction between client and server (SOAP wrapper)
  HTTP – to transport data
  WSDL (Web Service Description Language) for the description of data.
- Provides low barrier to entry solution using commonly available technologies
- XML format of records provide for more reuse, and more interesting use of resources

OAI –PMH: Open Archives Initiative Protocol for Metadata Harvesting

- Created to facilitate discovery of distributed resources.
- Simple, yet powerful framework for metadata harvesting based on common Web standards - HTTP, XML and XML schemas.
- Harvesters can incrementally gather records contained in OAI-PMH repositories and use them to create services covering the content of several repositories.
- The OAI-PMH has been widely accepted and implemented.

6.5 Educational Technology Standards

Educational technology standards are applied to all areas of e-learning. They are designed to facilitate the description, packaging, sequencing, delivery of and accessibility to educational content, learning activities and learner information.

It is not within the scope of this project to investigate standards and specifications related specifically to the design of learning materials. However it is important to note that:

- Spec and standards related to design of learning materials and learner management systems are produced by the same bodies that produce specs and standards related to the descriptions and exchange of material e.g. IMS, IEEE and other e-learning consortia.
- For true interoperability the whole system needs to be standards based.

6.6 Metadata infrastructure

Metadata: Metadata is data about data; descriptive information about resources for the purposes of finding, managing, and using these resources more effectively.

- Organises information
- Facilitates discovery of relevant information and resources.
- Promotes interoperability.
- Ensures long term preservation.
- Provides persistent and unique digital identification.
- Tracks the layers of rights and reproduction that exist for digital objects.
- Alleviates the problem of words with multiple meanings.

Types of metadata
Descriptive metadata describes the intellectual content and associations of a document or resource in a way that facilitates search, identification and collocation of information contained within or exemplified by the resource.
Structural metadata define the physical structure of a complex digital entity to facilitate navigation, information retrieval, and display.
Administrative metadata encompass a variety of data related to viewing, interpretation, use, and management of digital objects over time. Some examples of administrative metadata may include: • rights management statements (aka "rights metadata"); • information about the object's file characteristics or the capture or encoding processes used in creating the resource (aka "technical metadata"); • and information about the provenance of the digital resource and efforts to archive or manage the data for the long-term (aka "preservation metadata").

Metadata format standards

1. Dublin Core

- ANSI/NISO Z39.85-2001

- Intended to facilitate discovery of electronic resources (mostly descriptive metadata).
- 15 core elements

Title	Format
Creator	Identifier
Subject	Source
Description	Language
Publisher	Relation
Contributor	Coverage
Date	Rights
Type	

- Stable since December 1996
- Widely adopted internationally and in New Zealand, particularly National Library of New Zealand and TKI.
- Easy to use, doesn't require interpretation.

2. Dublin Core Education working group (see appendix B for schedule of elements)

It is realised that due to their nature the managing of learning objects requires metadata functions other than discovery.

The Proposed Dublin Core Education Schema adds to the basic Dublin Core with a particular focus on 5 areas of interest to education metadata projects.

- Users
- Duration
- Learning process
- Standards
- Quality

DC Education is:
15 Dublin Core elements
and DC Education extensions

DC Education Element : audience
DC Education Audience qualifier : mediator
DC Education Element : standard
DC Education Standard qualifier : identifier
DC Education Standard qualifier : version
DC Education Relation qualifier : conforms to

3 IEEE LOM elements
InteractivityType
InteractvityLevel

TypicalLearningTime

3. IEEE LOM

- IEEE 1484 LOM
- Extention of DC element set and architecture
- Created predominantly by IMS
- Related directly to the needs of education with specific focus on "learning objects".
- Very complex with over 80 elements with 9 broad category elements at top level.
- Needs interpretation and refinement.

LOM Data Element Categories

General – General context specific information.
Lifecycle – Lifecycle of resource (version, status, date, etc.)
Metametadata – Information about the metadata rather than the resource.
Technical – Technical features of the resource (format, size, location, requirements to display, etc.)
Educational - Educational (pedagogic) features of the resource (interactivity level, intended end user role, learning context, typical age range, etc.)
Rights – Conditions of use of the resource (cost, copyright, etc.)
Relation – Features of resource in relationship to other resources (kind, resource)
Annotation – Comments on educational use of the resource.
Classification – Description through taxonomy.

6.7 Application profiles and Modular Metadata

The trade off between using Dublin Core and IEEE LOM is one of weighing the goal of global discovery against the needs of a particular organisation.

The question of how to reach global consensus yet serve the distinct needs of individual organisations was addressed through the Ottawa Communique.
The Ottawa Communiqué:

- Lays out the foundation of agreement between Dublin Core and IEEE LOM with regard to finding solutions for interoperability in any domain using any set of metadata standards.
- Defines application profiles as the refining and adapting of a standard to meet the requirements of specific communities and domains.
- expresses the understanding by both parties that neither framework is going to satisfy all applications but seeks to establish commonalities that will allow not only the mixing of DC and IEEE but also other locally defined elements but still maintain a high level of interoperability.

Key principles of application profiles:
1. Modularity: this allows new combinations of metadata elements to be created based on established metadata schemas avoiding the need to reinvent new elements and without sacrificing cross-domain interoperability.
2. Extensibility: This refers to the concept of using a base schema (say Dublin core) and adding additional locally defined elements. This provides for local needs while maintaining the interoperability of the base schema.

Any system that also uses the locally defined elements would be able to read all the elements while other external systems would use the base schema elements and ignore the locally defined ones.

Application Profiles
International Examples

1. CanCore (Canada)
2. The Learning Federation (Australia)
3. SingCore (Singapore)

New Zealand Examples:

1. National Library of New Zealand
2. TKI (created by CWA)
3. Proposed Education Sector Metadata Schema (ESAF)

Modular Metadata
The principles of modular metadata suggests that rather than simply adopting a complex metadata schema such as IEEE LOM, create a complete metadata solution out of smaller, globally accepted metadata schemas that serve a particular purpose.

This allows greater flexibility and greater cross sector interoperability.
Central to this is the concept of **xml namespaces.** A name space declaration does the following:

- Identifies the metadata element set.
- Gives a web location where it is defined (specified by a URI)
- Identifies the prefix.

A namespace declaration in natural language would read as follows:

The Dublin Core metadata element set is defined at a Web location specified by a URI; all Dublin Core elements within the scope of this namespace declaration can be recognized by the prefix dc:

And in XML:

xmlns:dc=http://purl.org/dc/elements/1.1/

In the body of the XML document the prefix then declares what namespace the element belongs to.

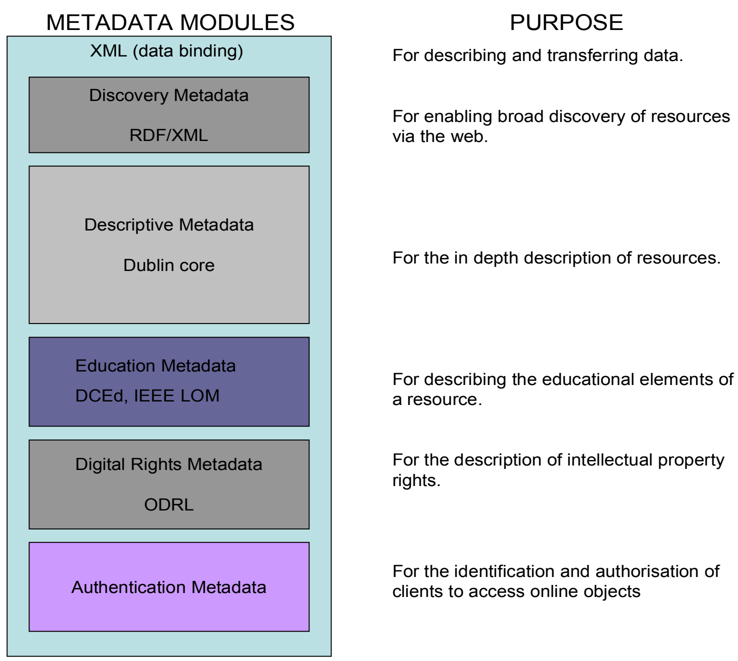
For example:

<dc:subject>**Carpentry**</dc:subject>

So when an application is using multiple metadata sets then the XML file for the metadata would contain multiple namespace declarations.

A modular approach to metadata in the TANZ environment might involve the following:

- Adopt Dublin Core as a base standard schema for resource discovery.
- Extend the base schema using other standard schema to satisfy the needs of TANZ objects management. Eg ODRL for Digital rights Management, DCEducation for education elements.
- Use XML namespace declarations.
- Formalise as an Application Profile.
- But must be compatible with National Library of New Zealand' Metadata Standards Framework and ESAF's Education Sector Metadata Schema.



6.8 Digital Rights Management

Digital Rights Management can refer to a number of different things that may include:

1. General expression of terms of access and use.
2. The encoding of those terms.
3. The enforcement of those terms through technology, this may include file protection and encoding.

The first is achieved through the metadata the second through applications. Metadata relating to DRM is being addressed by:

1. Open digital rights language
2. Motion Picture Expert Group
3. Creative Commons

- Some areas of DRM are more developed than others and have considerable amount of debate in different industries, most notably the music and publishing areas.
- In relation to e-learning no simple DRM solution has been widely implemented.
- This has been compounded by the confusion between Digital Rights Management and digital rights enforcement.
- Tension between sharing of learning objects and maintaining intellectual property rights.
- Before the best DRM system can be determined a clear set of requirements for rights management in the New Zealand education environment needs to be determined.

6.9 System architecture

There has been an evolution in recent years in thinking of a Learning Object Repository as a single system based in an individual institution to viewing it as a network of resources and services. This network can operate over the World Wide Web and include any number of institutions. Two major developments in system architecture have reduced implementation cost and increased connectivity between systems and organisations and made such a network possible; these are Open Systems and Service Oriented Architecture.

Open systems

Common concepts of open system architecture:

- Modular
- Standards based
- Non proprietary
- Layered structure that allows each layer to be implemented with out affecting the other layers.
- Component based architecture is not designed as a single software application but rather as a set of related components, each of which fulfils a specific function in the system as a whole.

Service oriented architecture and Web Services

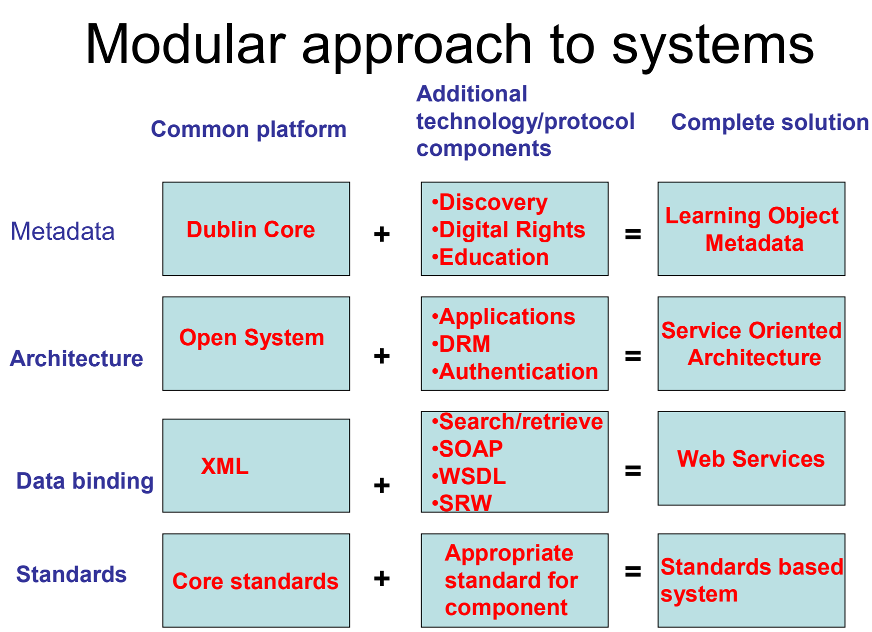
Service oriented architecture (SOA) builds on the open systems concept and is essentially making use of the flexibility of XML. It is still reasonably early in its development as standards are still being developed by the World Wide Web consortium (WC3). Web services signify a shift in focus from a web dominated by users and web browsers to an application centric web or programs talking to each other over the web.

The exact definition of a web service is still being debated however it is generally accepted that a web service is a Service Oriented Architecture with the following constraints:

1. Interfaces must be based on internet protocols such a HTTP,FTP, and SMTP.
2. Except for binary attachment, messages must be in XML.

Although the possibilities that Web services allows through a services oriented architecture have still not been fully realised it is fair to say that as long as you have implemented an open system and the data is bound in XML them the development of services is potentially limitless.

Principle of modularity applied to the whole system



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