Australian Flexible Learning Framework

Supporting Flexible Learning Opportunities

Introduction to Standards and Specifications for Learning Objects and Repositories

VET Learning Object Repository Project

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Introduction

This document is part of a suite of materials developed on behalf of the Australian Flexible Learning Framework in 2003 through the "VET Learning Object Repository" project. The project aimed to develop common understandings within the Australian Vocational Education and Training (VET) system, of the "Learning Object" concept and the requirements for digital repositories in which learning objects reside.

The aim of this paper is to provide the Australian VET sector a clear and concise summary of the most important standards and specifications, their pitfalls and benefits, and the associated conformance requirements. In particular, with a view to informing planned developments in the sector, it identifies the standards areas which are relevant to the creation of a national system of interoperable learning object repositories.

An overview of standards and specifications

Most Learning Management Systems (LMS) or content vendors today claim some level of compliance or conformance to technical standards to support online learning. This arises from the world-wide movement to promote interoperability in the e-Learning arena by establishing standards and specifications for learning content, and for the associated structures and systems which store and provide access to content for presentation to learners.

In recent years, standards supporting online learning and their use have generated significant debate both in Australia and overseas, so much so that this has led to a general sense of confusion and concern among training organisations as to exactly what standards are and what benefits they may hold. To facilitate this, it is important to distinguish between standards, specifications and the related term "reference model", which despite their similarities, serve different purposes.

> **Standards:** Standards can only be created by an official standard-setting body. Internationally, the key standards body is the International Organisation for Standardisation (ISO). The ISO's JTC1 SC36 sub-committee sets information technology standards for learning, education and training.[1]
>
> Standards are also developed by organisations such as the IEEE (International Electrical and Electronic Engineering Association) Learning Technology Standards Committee (LTSC) which "is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology."[2] The Learning Object Metadata (LOM) standard is an example of an important standard developed by the IEEE.
>
> **Specifications:** Unlike standards, specifications are developed by organisations to define the functional requirements for particular processes and products. With respect to learning content, these normally focus on how to structure information to support interoperability (the ability for two different systems to share information and therefore to substitute for one another or to share content and data as part of a unified workflow). For this reason,

[1] JTC1 SC36 website http://www.jtc1sc36.org/
[2] IEEE LTSC website http://ltsc.ieee.org

specifications tend to be quite specific in their requirements and traditionally provide significant detail of how the specifications should be implemented. Specifications sometimes mature into standards.

In the learning world, many important specifications are being developed by the IMS Global Learning Consortium, Inc. The IMS Consortium brings together members from educational, commercial and government organisations for the purpose of developing interoperability specifications for the learning industry.

Reference models: Reference models are collections of standards and specifications, often with additional rules that spell out how the different standards and specifications work together. In many cases, reference models are open to interpretation and do not necessarily provide the same level of detail as specifications.

The Shareable Content Object Reference Model (SCORM) is an example of a reference model of significant importance within the learning industry. This model was developed by the ADL (Advanced Distributed Learning) initiative, established by the US Department of Defence, along with industry and academic partners.

The evolution of standards

In the context of learning technology, it should be noted that standards and specifications are constantly evolving. Standards organisations such as the IEEE and the ISO keep records of normative standards that provide references necessary for conformance and interoperability (Sonwalker, N. 2002).

The development process of formal standards is both laborious and time consuming, and requires numerous components and collaboration as depicted in the diagram below.

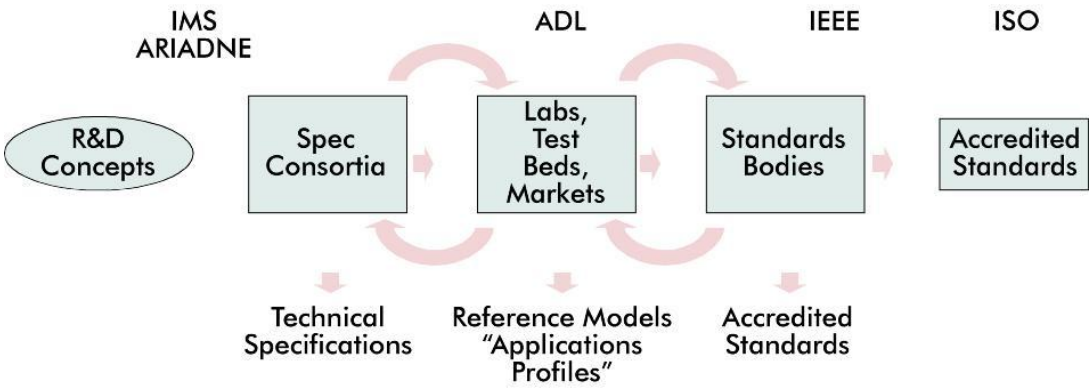

Figure 1: The standards development process
Adapted from Philip Dodds (ADL Co-Labs)

Australia's role in international standards development

Australia plays a key role in these international developments through active participation and prominence in international standards fora including the IMS Global Consortium, ISO/IEC JTC1 SC36, Dublin Core, IEEE and ADL, and nationally through interoperability and standards-centric projects sponsored by ANTA, FLAG, education.au limited, the MCEETYA ICT in Schools Taskforce, the Le@rning Federation, the Macquarie ICT Centre for Excellence (MELCOE), the National Office for the Information Economy and DEST.

Standards Australia also contributes to the work of the International Standards Organisation ISO/IEC JTC1 SC36, Information Technology for Learning, Education & Training Committee[3] through the operations of the IT-19-01 sub-committee which promotes interoperability and reusability of information technologies for learning, education, and training in Australia.

Another key body in the Australian context is the Australian Information and Communications Technology in Education Committee (AICTEC). AICTEC is the cross-sectoral, national committee responsible for providing advice to all Australian Ministers of Education and Training on the economic and effective utilisation of online technologies in Australian education and training.[4] Although the committee doesn't establish standards, it is an important advisory body on standards matters. As an example, it has endorsed the EdNA Metadata Standard[5] as a set of guiding principles and metadata elements for use by the Australian education and training sector.

The AICTEC Standards and Interoperability Committee (ASIC) works with groups to develop, implement and promote technical standards to support the use of computers in learning, education and training. The Committee maintains a website[6] that provides information and documentation to users and developers of online products and which supports discussion and information exchange on the use of standards and specifications across Australian education and training jurisdictions.

Learning objects and standards

Historically, training facilitators have used a range of resources in their work including student handouts, overhead transparencies and photographic slides. One of the key advantages of this approach is that a trainer could "mix-n-match" these resources at will as curriculum and context changed. In the e-Learning environment trainers now have access to a wide variety of digital resources, including video-clips, graphics, interactions and HTML content pages. Naturally, the ability to access, use and reuse pieces of these resources when designing a course is of great benefit to the course designer and provides a tangible return on investment.

However, in order to do this, there is a need to create these "learning objects" in a standard fashion so that they can not only be used and reused within the learning organisation but also have the potential for use elsewhere. e-Learning specifications and standards enable this interoperability: between multiple learning content management systems (LCMS), a variety of learning object repositories (LOR) and end users (Forth, S. & Childs, E. 2003).

[3] ISO/IEC JTC1 SC36 website http://jtc1sc36.org/
[4] AICTEC website http://www.aictec.edu.au
[5] EdNA Metadata Standard http://www.edna.edu.au/metadata
[6] AICTEC Technical Standards website http://standards.edna.edu.au

The issue of interoperability

Of significant interest to the VET Learning Object community is the challenge of interoperability. Interoperability promises ease of access to learning resources and promotes the sharing of content across the VET sector, achieving significant efficiencies in resource development.

The AICTEC Standards sub-committee identifies the following areas in which technical standards are relevant to education and training (and hence in which interoperability is an issue):

- **Network infrastructure**: general infrastructure to permit transmission of data and standards for transfer of particular types of media (text, audio and video).
- **Content formats:** standards for the storage and presentation of components of online content (text, graphics, audio and video files). Also covers programming languages and accessibility issues.
- **Resource description and resource discovery:** covers metadata, search interfaces and vocabularies necessary to assist reliable resource discovery.
- **General applications:** covers web publishing, email, workgroups and video conferencing.
- **Delivery platforms and content packaging:** covers software systems used to manage the delivery of online content to students.
- **Administration and management:** covers such areas as student records and educational statistics (Backroad Connections Pty Ltd 2002).

Achievement of this goal would be significantly advanced by the adoption across the sector of a common series of specifications for the most relevant functions. With this list in mind, three areas have been selected as areas of particular importance for inclusion in this paper: content packaging, metadata and the specifications to support repository interoperability.

Content packaging

Content packaging is the structured packaging of raw content and resources in a standard manner to facilitate discovery and interoperability within a digital environment. This requires:

- a standard and flexible metadata application profile
- a standard way to aggregate multiple resources of various types
- a standard way to express structural relationships within the resource collection.

There is a current need within the Australian VET sector to adopt a suitable content packaging specification that would meet these requirements.

Metadata

Metadata is essentially data about data. There are currently a number of metadata standards available and from this a number of metadata application profiles have been developed and are in use in the Australian VET sector.

A metadata application profile is an assemblage of metadata elements selected from one or more standards, structured in such a way that it is able to meet the functional requirements of a particular organisation or community, while retaining interoperability with the original standards. Part of such an

adaptation may include the elaboration of local metadata elements that have importance in a given community or organisation, but which are not expected to be important in a wider context.

An interoperable national system would be well-served by the development of a commonly accepted metadata application profile for the Australian VET sector.

Digital Repository Specifications

Specifications in the context of this paper refer to the technical specifications that need to be implemented by developers of both repositories and learning resources to facilitate the development, discovery and re-use of learning resources.

Several specifications are currently in existence, and others are under development, but there is yet be a national approach to the further development or acceptance of these specifications.

The VET sector needs to focus on the current work being done with standards and to conduct a range of trials of these standards within the Australian VET context.

These three areas are the primary focus for the remainder of this paper.

Relevant e-Learning standards and specifications

Standards and specifications are constantly evolving. Standards organisations such as the Institute of Electrical and Electronics Engineers (IEEE), the International Organisation for Standardisation (ISO), and Standards Australia are responsible for maintaining records of approved standards and associated requirements for conformance and interoperability.

This section provides an overview of some of the more commonly used standards and specifications within the e-Learning environment. Most of these are internationally recognised and have been developed through the processes previously described. The trend in standards development is towards seeking international consistency, and the work of Australian organisations can be seen as contributing to this movement.

Key IMS specifications

The IMS is an industry-sponsored organisation that develops specifications for the learning industry. The IMS has been responsible for developing a number of key e-Learning specifications internationally. The most important of these are outlined below.

IMS content packaging

This specification provides a common framework for the packaging and description of learning material. The specification is aimed at both content developers and learning management system vendors. Content packaged in XML format in accordance with the specification could be distributed on a range of compliant learning management systems.

The IMS specification defines a package as a chunk of re-usable content. It is represented in the form of an XML manifest file with the predefined name *imsmanifest.xml*. See diagram:

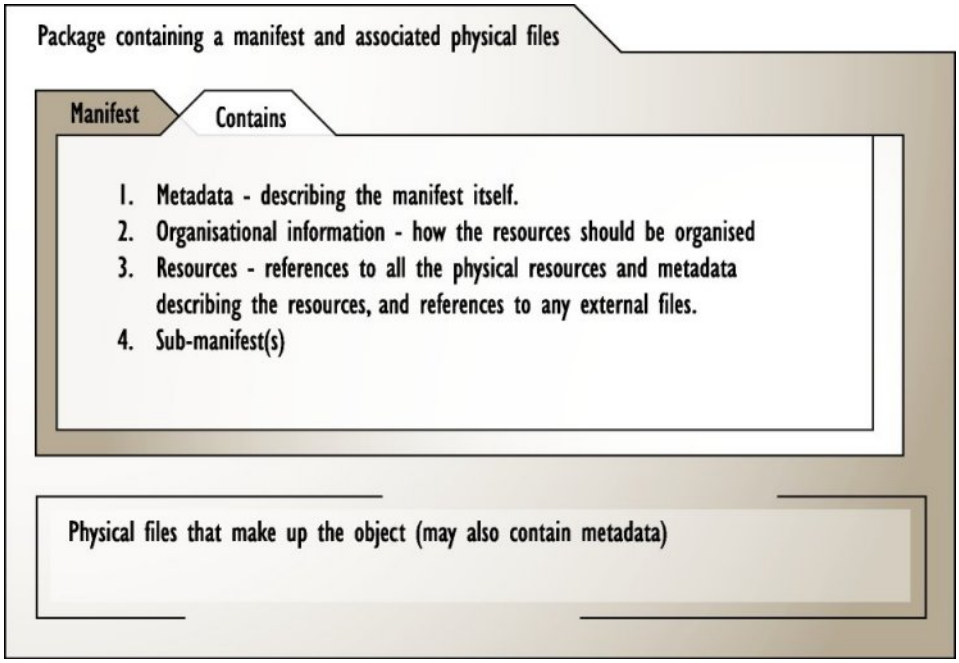

Figure 2: Graphical representation of the IMS XML manifest

The full specification is available at
http://www.imsglobal.org/content/packaging/index.cfm

IMS metadata: These specifications describe metadata elements based upon the Learning Object Metadata (LOM) work done within the IEEE Learning Technology Standards Committee – LTSC (known as IEEE LOM). This specification provides a way to format the IEEE LOM in XML. This is sometimes called the XML binding.

According to the IMS Global Learning Consortium (2001) the LOM metadata (containing almost 80 elements) is broken up into nine categories. These categories are based on the definitions found in the LOM Information Model. The nine categories of metadata elements are:

1. The General category is used to describe general information about the learning object as a whole.
2. The Lifecycle category is used to describe features related to the history and current state of the object and those which have affected it during its evolution.
3. The Meta-metadata category is used to describe information about the metadata record itself.
4. The Technical category is used to describe technical requirements and characteristics of the learning object.
5. The Educational category is used to describe the educational and pedagogic characteristics of the learning object.
6. The Rights category is used to describe the intellectual property rights and conditions of use for the object.
7. The Relation category is used to describe features that define the relationship between the object and other targeted components.
8. The Annotation category is used to provide comments on the educational use of the object and information on when and by whom the comments were created.

9. The Classification category is used to describe where the learning object falls within a particular classification system.

The IEEE LOM metadata definition is best represented as a simple hierarchy. The IEEE conceptual model for metadata definitions is a hierarchy. At the top of the hierarchy is the "root" element. The root element contains many sub-elements. If a sub-element itself contains additional sub-elements, it is called a "branch". Sub-elements that do not contain any sub-elements are called "leaves". This entire hierarchical model is called the "tree structure" of a document as depicted below.

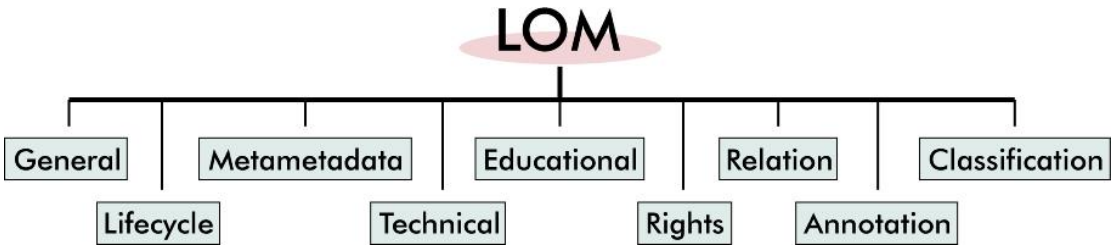

Figure 3: The LOM tree structure. Adapted from IMS Learning Resources Metadata Best Practice and Implementation Guide, Version 1.2.1 Final Specification 2001

According to the IMS Learning Resource Metadata Best Practice and Implementation Guide Version 1.2.1 Final Specification:

> "A metadata instance conforms to the IMS metadata specification if it satisfies the following four requirements:
>
> - The metadata instance must contain one or more LOM element(s).
> - All LOM elements in the metadata instance are used to describe characteristics as defined by the LOM spec. (This means that one shall not abuse for instance, the <title> element to describe the fonts used in the document.)
> - Values for LOM elements in the metadata instance are structured as defined by the LOM specification and this structural information is carried within the instance. This means that the grouping in categories and sub-elements must be maintained. But it does not mean that representations cannot define mappings of this structure as they see fit.
> - If the instance contains extensions to the LOM structure, then extension elements do not replace elements in the LOM structure."

The full specification is available at http://www.imsproject.org/metadata/index.cfm.

IMS Digital Repositories Interoperability Specification

The IMS Digital Repositories Interoperability (DRI) Specification was released in January 2003. It provides a set of recommendations to assist interoperability between repositories. The specifications define repositories as collections of assets or metadata that describes assets that are accessible via a network. The specification builds on other relevant specifications such as IMS content packaging and the IMS metadata specification.

The DRI specification addresses how users and tools interact with repositories to input, discover, locate, and deliver learning object metadata and the associated content. It does this by defining a specific set of functions and protocols that enable a diverse range of e-Learning systems to communicate with each other.

It is based on established standards such as the Simple Object Access Protocol (SOAP with attachments) and the XQuery XML search language developed by the World Wide Web Consortium. The specification allows for a wide range of content formats such as may be found in a learning object repository.

The specification defines some core functions that facilitate the interoperability of digital repositories. The four main functions described in this specification are:

Search / Expose
Gather / Expose
Submit / Store
Request / Deliver

The IMS Digital Repositories Interoperability - Core Functions Information Model (2003) describes each of these functions as follows:

Search/Expose function

This function defines the searching of metadata associated with content exposed by the repositories. The recommendation is to use XQuery to search IMS (XML) metadata records and use the Z39.50 standard to search library information. In order to search across various repositories, which support different search formats, a search intermediary is to be implemented to translate one search format to another (e.g. from "XQuery" which searches native XML databases to "SQL statement" which searches relational databases).

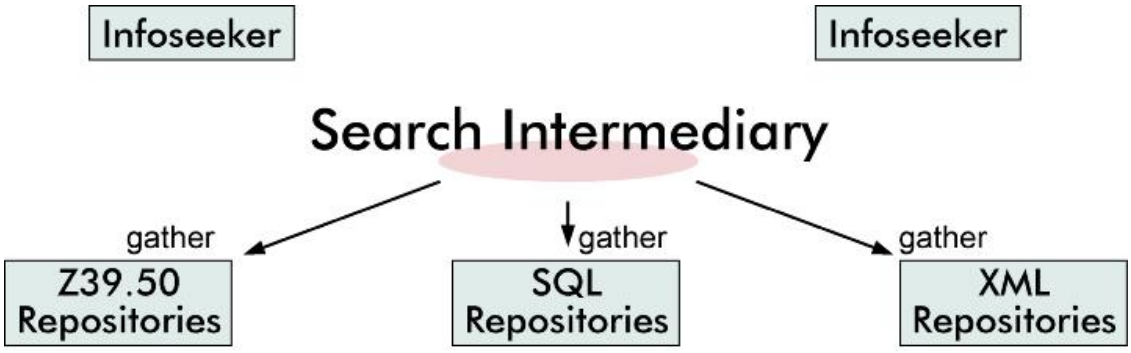

Figure 4: Digital Repository Interoperability Specification Search/Expose function. Adapted from IMS Digital Repositories Interoperability - Core Functions Information Model

Gather/Expose function

This function describes how metadata exposed by repositories is being solicited and how to aggregate the metadata for use in subsequent searches. The idea of the DRI specification is to gather all metadata records from various repositories to a central repository as shown in Figure 5. The recommendation is to either use:

- Pull factor -- Open Archive Initiative (OAI) model to pull metadata to a central repository based on the date the metadata was updated or

- Push factor -- Send an alert-like email to a subscribing database to inform that the metadata record has been changed.

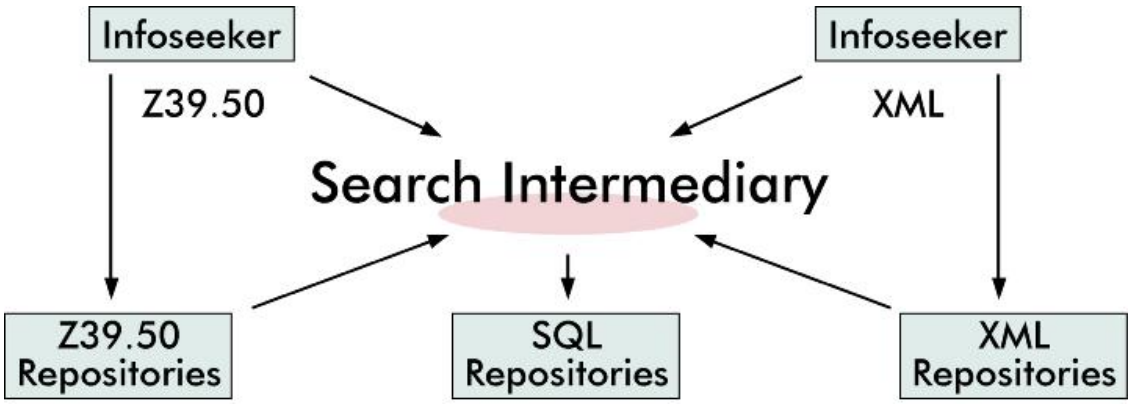

Figure 5: Digital Repository Interoperability Specification Gather/Expose function. Adapted IMS Digital Repositories Interoperability - Core Functions Information Model

Submit/Store function

This function refers to moving an object to a repository from a network-accessible location and how the object will then be represented for future access. The recommendation is that existing repositories may use established means like FTP while repositories that are recently being developed may consider transmission using SOAP (Simple Object Access Protocol) messages with attachments. The repository should preferably store and transfer IMS content packages.

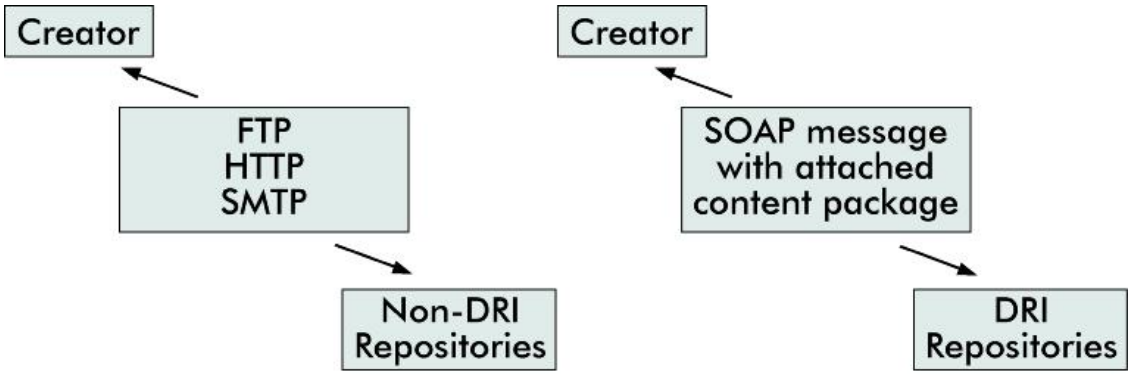

Figure 6: Digital Repository Interoperability Specification Submit/Store function. Adapted IMS Digital Repositories Interoperability - Core Functions Information Model

Request /Deliver function

This function allows a person who has located a metadata record via the Search function to access the resource described. It also describes the response from the repository, which provides access to the resource. The mechanism should begin with a pointer to the location of a resource, IMS metadata element 4.3 <location>. In order to be uniquely identified during the request and delivery of metadata and resources, IMS recommends the use of DOIs (Digital Object Identifiers), openURLs or PURLs (Persistent Uniform Resource Locators - www.purl.org) in order to have unique

identifiers across multiple repositories. The protocols used to deliver the learning resource should include http and ftp.

The current DRI specification, does not address areas such as digital rights management, verification, e-commerce payment and processing, which are seen as important areas for future development.

The DRI is intended to be an international specification for the development and implementation of repositories. The following table summarises some of the major recommendations of the specification.

Summary of recommendations contained within the IMS DRI specification	
Searching	Use Xquery for XML metadata Use Z39.50 for SQL databases
Web Services Messaging	Use SOAP with attachments over HTTP
Metadata	Use IMS Metadata Specifications
Content Packaging	Use IMS content packaging specifications
Learning Object Specification	DRI does not prescribe a specification for learning objects
Identification of Learning Objects	Use the DOI – Digital Object Identifier

A full version of the documentation is available at http://www.imsproject.org/digitalrepositories/index.cfm.

Additional specifications from IMS

The specifications described below are additional to the key group which are the main subject of this paper. However they are seen as relevant and included as they add functionality (or will do so in the future) to aspects of learning content packaging and access.

IMS Simple Sequencing

This specification describes the manner in which learners receive individual pieces of content (known as activities) from the LMS. Simple Sequencing does not permit one activity to call another activity directly. The LMS controls the movement of the learner from activity to activity with inter-activity sequencing. The LMS essentially performs all the branching of the content based on behaviours defined by the designer. This allows sets of activities to be sequenced in many different ways.

This specification is expected to grow in importance, as it adds functionality to the designer's ability to create navigation paths for different learning strategies. For example, one learning strategy might require that learners go through each resource in a specific sequence; in another, the sequence might depend on the learner's profile, while yet another sequence might be based on adaptive learning, in which the learner's choices or performance determine the sequence for subsequent learning resources. This specification will be the key new component in SCORM Version 1.3.

Note: Intra-activity branching does not constitute Simple Sequencing or need to adhere to Simple Sequencing guidelines, as it is not controlled or tracked by the LMS. This can be a disadvantage if tracking of learner behaviour and reporting on progress at each step is seen as important.

The full specification is available at
http://www.imsglobal.org/simplesequencing/index.cfm

IMS Learning Design

Based on the Educational Modelling Language (EML) developed at the Open University of the Netherlands, this specification provides a way to describe different learning strategies and how learning resources fit into these strategies. In the future, this specification will be used to share learning designs across systems and to fit learning resources into learning designs.

The full specification is available at
http://www.imsglobal.org/learningdesign/index.cfm

IMS Question and Test Interoperability (QTI)

This specification describes how questions, tests and their results can be described in XML so that they can be used in different systems.

The full specification is available at http://www.imsglobal.org/question/index.cfm

EdNA metadata

EdNA (Education Network Australia) is “a service which aims to support the benefits of the Internet for learning, education and training in Australia…. It is funded by the bodies responsible for education provision in Australia - all Australian governments.“ (EdNA website)

In 1998, EdNA released the first version of its metadata standard, initially to support resource discovery and management of resources for its EdNA Online website. The current version 1.1 was released in December 2000.

The EdNA metadata standard is based on the Dublin Core Metadata Element Set (DCMES) and is consistent with the Australian Government Locator Service (AGLS).

DCMES was one of the first metadata standards for digital information to be widely adopted. The standard has a core set of 15 elements that cover a broad range of domains. Many domain specific standards organisations adopted the Dublin Core set and then added elements to cater for their particular industry information.

In addition to the Dublin Core set, the EdNA standard includes a few EdNA specific categories such as:

- EDNA.Audience
- EDNA.Approver
- EDNA.CategoryCode
- EDNA.Entered
- EDNA.Indexing

- EDNA.Review
- EDNA.Reviewer
- EDNA.Version

These additional categories are primarily for the purposes of administration and maintenance.

Whilst the EdNA metadata standard is being used quite broadly, there is currently no general agreement in the education sector about minimum requirements for metadata for a specific resource. This means that the metadata applied to a resource may differ from organisation to organisation and potentially poses problems for interoperability across different systems if used on a national resource sharing level between one or more sectors or organisation. A standard minimum set would prevent this problem easily.

The current EdNA metadata standard 1.1 was primarily intended to facilitate discovery of online educational resources and not intended as a standard for learning object repositories.

A full copy of the specification is available at http://www.edna.edu.au/metadata/documents/edna_metadata.pdf

SCORM

The Sharable Courseware Object Reference Model (SCORM), also more recently referred to as the Shareable Content Object Reference Model Initiative, was released by the Advanced Distributed Learning Network (ADL) in January 2000.

SCORM is a set of specifications for developing, packaging and delivering education and training materials whenever and wherever they are needed. SCORM-compliant courses aim to leverage course development investments by ensuring that compliant courses are “RAID”:

- **Re-usable:** easily modified and used by different development tools
- **Accessible:** can be searched and made available as needed by both learners and content developers
- **Interoperable:** operates across a wide variety of hardware, operating systems and web browsers
- **Durable:** does not require significant modifications with new versions of system software.

The SCORM specification is actually a collection of specifications to create a “unified content model” to enable the re-use of learning materials across a range of products and platforms (Advanced Distributed Learning, 2003). It includes:

- specifications for representing course structures or content aggregation
- specifications relating to the run-time environment
- specifications for creating metadata records for courses, content, and raw media elements
- specifications for content packaging to enable interoperability.

Full details of the specification and other related documents are available from the Advanced Distributed Learning website (http://www.adlnet.org).

SCORM Content Aggregation Model

The SCORM Content Aggregation Model describes the content being delivered so that it can be imported into an LMS. Content is divided into modules with multiple modules being combined to form a content aggregation. The content model describes the relationships between these modules.

The content model also describes the physical structure of the content (files needed, etc) as either Assets or SCOs as such it has three primary components: Assets, Sharable Content Object (SCO), and Content Aggregate.

Assets:
An asset is the smallest form of learning content. An asset is simply an “electronic representation of media, text, images, sound, web pages, assessment objects or other pieces of data”. Examples of assets include images, sound clips, Flash slides, etc.

Sharable Content Object (SCO):
The definition of an SCO is deliberately vague; it can be defined as a single web page or as an enormous and complex web-based training module containing hundreds of pages and hundreds more images and other assets. The definition of an SCO is left up to the content author to define under the guidance that an SCO should represent the smallest unit of learning that the LMS should track. Each SCO should be universally re-usable. To achieve re-use, an SCO should not be context sensitive, it should not reference other SCOs, and it should not link to other SCOs.

Content Aggregate:
A hierarchical representation of SCOs and/or other elements, aggregated to form higher-level units of instruction.

SCORM Runtime Environment

The Runtime Environment specifies how the content should behave once it has been launched by the LMS. A SCORM compliant LMS is required to implement an API (Application Program Interface) consisting of eight functions that content may access to communicate with the LMS (Advanced Distributed Learning 2003).

This API is implemented by what the SCORM calls an API Adapter. The API Adapter must reside in a window that is a parent window or a parent frame of the window that contains the content. This means that the LMS may launch the content either in a new window or in a frameset. The API Adapter must be an ECMAScript (JavaScript) object named "API".

All communication between the SCO and the LMS is handled by the runtime environment API. The standard API consists of eight functions which can be categorized into three main types; Communications, Variable passing and Error detection and diagnostics. These functions are described briefly in the table below:

Category	Function	Description
Communications	[LMSInitialize()] [LMSFinish()]	These two functions are used to control communications between the content and the LMS
Variable passing	[LMSGetValue()]	These three functions pass variables

	[LMSSetValue()] [LMSCommit()]	to and from the content to the LMS.
Error detection and diagnostics	[LMSGetLastError()] [LMSGetErrorString()] [LMSGetDiagnostic()]	These three functions are used to detect and send error messages to the LMS.

Of these eight only the Initialise [LMSInitialize()] and the Finish [LMSFinish()] function are compulsory to communicate with the LMS.

Implementing this API in the LMS is a little more involved; it has to implement all of the API functions and support most of the SCORM data model. The tricky issue involved with implementing a SCORM compliant LMS is how to handle the browser-to-server communication. Most people choose to do this with a Java applet, but others have been successful using Flash, ActiveX controls and pure JavaScript (Rustici Software. 2003).

SCORM Metadata Specification

The SCORM Metadata Application Profile directly references the IEEE Learning Object Metadata (LOM) standard and the IEEE Draft Standard for Extensible Markup Language (XML) Binding for Learning Object Metadata Data Model. The metadata specification defines a very rich data model of approximately 64 metadata elements; however, only a small subset of the data elements is required to achieve SCORM compliance.

ADL strongly recommends the use of the IEEE LOM for describing the SCORM content model components, although it does recognise that other metadata schemas may be used with the risk that they may not be recognised by some systems (MASIE Center 2003).

SCORM Content Packaging

SCORM uses the IMS Content Packaging Specification developed by the IMS Global Learning Consortium. The content packaging specification defines how training should be packaged digitally to facilitate sharing learning resources.

Basically, the content packaging model dictates that the data from the content model should be stored in an XML file named imsmanifest.xml at the root of your package. Metadata elements should be stored in arbitrarily named XML files (referenced by imsmanifest.xml). Content packaging also describes how to package data physically onto disk and how to compress the data into what is called a PIF file (basically a zip) (Rustici Software 2003).

SCORM compliant learning management systems are able to interpret the instructions in the manifest file, unpack the package and present the resources to the user.

An example of specifications in use - The Learning Federation

Having reviewed the main standards and specifications relevant to learning object interoperability, this section considers the work of the Learning Federation as an example of the use of international specifications integrated with features based on local requirements.

The Learning Federation is an initiative on behalf of the Australian and New Zealand schools sectors which develops online content for use in support of school curricula and provides access to it through a learning object exchange.

The Le@rning Federation has put significant work into the development of a set of technical specifications for the development of learning objects. The current specifications make reference to the EdNA Metadata Standard, v1.1.

The Le@rning Federation's specifications address the following areas:

- Content development
- Metadata
- Web services.
- Educational soundness
- Rights management
- Accessibility

Of these, the first three are the most pertinent to the subject matter of this paper. The following pages provide brief descriptions of each of the specifications, including the latter three which have been included for contextual completeness.

Technical specifications for content development

The Le@rning Federation defines a learning object as "a digital resource facilitating learning experiences related to a particular educational purpose" and has provided a series of technical specifications for learning objects based on the following principles:

- Accessibility
- Useability
- Interoperability
- Flexibility
- Durability
- Scalability.

The current specification provides information on the learning object model as containing resources, organisations, and metadata using the IMS Content Packaging v1.1.3 specification. The specifications continue to describe the packaging and structure of learning objects as well as a detailed specification of the content model requirements for learning objects and permissible media types and formats.

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Tech_Specs_Content_Develop_V3_0.pdf

Metadata

The Le@rning Federation has developed a Metadata Application Profile to support the access, search, selection, use, trade and management of learning objects. This

application profile is based on international metadata standards[7] and supports best practice.

The Metadata Application Profile supports the following principles:

- adoption of international metadata standards that are compatible with other Australian education sectors without compromising the goals of Australian school education
- adoption of metadata standards that do not compromise school education systems and sectors in achieving their own educational priorities
- recognition that optimisation of the learning value of digital learning objects is fundamental in establishing interoperable metadata specifications for the Le@rning Federation
- recognition that metadata needs to support the access, search, selection, use, trade and management of learning objects
- recognition of the tension between the processes involved in the international and national standards initiatives.

The Le@rning Federation's Metadata Application Profile has been specifically created to support not only the search, retrieval and use of learning objects, but also to support a range of repository management issues including:

- management of files and learning objects
- description of the educational purpose and value of learning objects
- technical interoperability between information systems using learning objects
- management of the digital rights associated with learning objects
- inclusive access to learning objects.

Within the Application Profile, metadata elements are grouped into the following five categories:

- **Management**: groups the information that describes the digital asset as a whole and its management.
- **Technical**: groups the technical requirements and characteristics of the digital asset.
- **Educational**: groups the educational and pedagogical characteristics of the digital asset.
- **Digital rights**: groups the intellectual property rights and conditions of use for the digital assets.
- **Accessibility**: groups the accessibility characteristics of the digital asset.

From a pedagogical perspective the application profile supports description of the educational integrity of a learning object. The metadata includes elements for describing:

- the object's curriculum topic
- the potential learning outcomes supported by the object
- teaching methods for presenting the material
- the intended audience for the object.

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Application_Profile_1_2.pdf

[7] Dublin Core Metadata Element Set, v1.1; EdNA Metadata Standard, v1.1; and IEEE learning object Metadata Standard, draft v6.4

The Le@rning Federation Metadata Application set uses different metadata associated with educational content depending on the quality assurance status of that content. Within the Exchange, states that influence metadata are:

- **Draft status:** Educational content is assigned "draft status" when it is first uploaded to the exchange by educational content developers.
- **Approved status:** Content is assigned "approved status" when it has satisfied all requirements of the quality assurance process.
- **Published status:** Content is assigned "published status" when it is made available for export from the Exchange to the education systems.

The recording of status is mandatory within the specifications.

As content progresses through the content life cycle, more metadata is added, and different metadata elements are mandatory depending on the status of the content within the quality assurance process.

The full specification of Metadata Application Profile Mandatory Elements is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Mandatory_Elements_1_1.pdf.

Web service specification

The Le@rning Federation's Web Service specification defines a web service for interacting with the Exchange repository of learning objects. The web service provides a simple programmatic interface allowing client systems to discover and download metadata and learning objects from the Exchange.

The specification is based on the following principles:

- Simple discovery of learning objects, including
  - Ability to discover new learning objects
  - Ability to see aggregation relationships between discovered learning objects
- Simple download of aggregated learning objects
- Use of standard metadata and learning object packaging technologies.

The web service uses a Simple Object Access Protocol (SOAP) consisting of four operations:

- Query learning object
- Download learning object
- Retrieve learning object metadata
- Test connection.

The full specification of Web Service Specification is available at: http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/SOAP_Specification_V0_4.pdf. This specification is in draft form and is currently under review.

Educational soundness

The Le@rning Federation describes educational soundness as "the capacity of online curriculum to successfully promote student learning". This would seem to be a concise and adequate definition and is consistent with the IEEE's Learning Technology Standards Committee (LTSC) widely accepted definition of a learning object as "any entity, digital or non-digital, which can be used, re-used or referenced during technology-supported learning".

The Educational Soundness Specification is underpinned by the following four principles:

- learner focus
- integrity
- useability
- accessibility.

To support the inclusion of context, the Le@rning Federation's "educational soundness" specification states that:

"Online content will have learner focus when it has purpose, meaning and relevance for the learners and it:

- enables learners to interact with, organise, represent, interpret and manage the process of learning and the information flow
- makes explicit the intended process/es of learning
- contextualises student learning by making connections with prior learning and likely future learning."

Full details of the specifications are available online at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/educational_soundness_specification_v2_2.pdf.

Rights management

The Rights Management specification developed by the Le@rning Federation has been based on national and international best practice and is designed to protect copyrighted material from unauthorised use as specified under the Copyright Act 1968.

It is based on the four principles of:

- equitable rights licensing
- authoritative rights branding
- flexible rights trading
- legal rights compliance.

What is most important within these specifications is the ongoing work being undertaken by the Le@rning Federation on a range of initiatives in digital rights management. These include:

- developing licensing models for intellectual property based on emerging multimedia licensing best practice
- formulating a clear and extensible rights management information model
- using the Open Digital Rights Language (ODRL) as a standard vocabulary for digital rights metadata
- using a Digital Object Identification (DOI) numbering system described within EdNA and IMS metadata standards.

Full details of the specification are available online at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/rights_management_specification_v1_2.pdf

Accessibility specifications

The accessibility specification developed by the Le@rning Federation conforms to Commonwealth laws regarding accessibility and aligns itself with international best practice. The specification consists of the following eight principles:

- legislative compliance
- appropriate learning object design
- authoring tool design and operation that supports accessibility of content
- access device independence
- customisation based on user preferences
- provision of contextual and orientation information
- provision of accessibility rating of content
- provision for specification of a level of telecommunications and hardware/software compliance.

Through meeting the seven checkpoints, the Le@rning Federation's specification also meets the standards set by W3C, as well as adherence to the Human Rights and Equal Opportunity Commission (HREOC) under section 67(1)(k) of the Disability Discrimination Act 1992 (DDA).

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Accessibility_Specification_V1_5.pdf

Summary of implications for the Australian VET sector

Australian Flexible Learning Framework plans for 2004 have identified the need to establish a range of interoperable resource repositories with a view to facilitating access, sharing and transfer of learning resources in the VET sector based on compatible standards.

At the beginning of this document, three specification areas were identified as critical to improving interoperability in access and use of online resources: content packaging; metadata; digital repository specifications. The following implications for VET can be drawn from this review of the available standards.

Content packaging

IMS content packaging is a well accepted specification world-wide and is likely to be the key reference in this area for Australian VET sector if consistency with international movements is to be sought. It also forms an important part of the SCORM reference model.

Extending on the use of IMS content packaging, SCORM itself holds many potential advantages for the sector. These include the ease of integration with an LMS, promoting the sharing and re-use of learning content, and the benefits of being interoperable across a range of platforms. SCORM is supported by a variety of Learning Management Systems such as WebCT and Blackboard. In recent times, the courseware development industry has also seen a number of development tools such as Macromedia Flash and Dreamweaver release add-ins that facilitate the development of SCORM compliant content.

It should be noted, however, that there is some debate about the suitability of SCORM for the Australian VET sector. In an article appearing on the CETIS website

in late 2002, Dan Rehak[8] is quoted as saying that SCORM "has a limited pedagogical model unsuited for some environments" (Kran, W. & Wilson, S. 2002). It has also been characterised as "oriented to a single user, self-paced, instructionist content centric specification." (Higgs, P., Meredith S., and Hand T. 2003) These potential educational limitations have been recognised as requiring further exploration before the adoption of the SCORM model in its entirety is recommended.

To inform the debate further, a discussion paper has been prepared as part of the VET Learning Objects Repository Project to be titled "Potential Benefits and Challenges in the use of SCORM in VET". In addition, a series of practical trials are being conducted using material from the Flexible Learning Toolboxes to examine the suitability of SCORM content packaging for the VET sector.

Metadata

Metadata is an integral component to any repository and is the key to not only discoverability but also interoperability.

There are currently two main metadata standards relevant to learning objects in the VET sector: EdNA Metadata Standard and the IEEE's Learning Object Metadata (LOM) Standard.

The EdNA metadata standard is currently being used quite widely across the VET sector for resource discovery and is the standard applied to the Flexible Learning Toolboxes (national online resources developed for the VET sector through the Australian Flexible Learning Framework).

Given its wide use, the EdNA standard could be expected to form the basis of a metadata application profile for the sector. The mapping of EdNA metadata to other metadata systems would be an essential part of the task.

The IMS LOM standard is useful for describing educational attributes and provides a rich structure for classification of learning resources. It has recently become the defacto standard for many international organisations. While the full metadata set may be too complex for many users, any metadata application profile developed for the VET sector would be well advised to reference (or map to) the LOM to facilitate interoperability with other major systems including SCORM.

Currently, there is no agreement within the VET sector about minimum metadata requirements. This potentially poses problems for interoperability across different systems if used on a national resource sharing level between one or more sectors or organisation. A national system of resource repositories would benefit significantly from the development of a common metadata application profile for the sector.

Digital Repository Specifications

The IMS Digital Repositories Interoperability (DRI) specification is the first international specification in this area and only recently released. This is largely a technical document that establishes a range of specifications for the search, retrieval and storage of learning resources within a digital repository.

[8] Described as one of the "chief architects" of SCORM.

The IMS DRI is an obvious choice as the basis for trialling the development of interoperable learning object repositories within the VET sector. The process of trialling can be expected to highlight adaptations which may be necessary to meet the conditions required by the sector. However, the process of test and trial is essential if solutions to interoperability problems are to be found.

Appendix A The specifications and standards

SCORM

Advanced Distributed Learning Sharable Content Object Reference Model (SCORM) Version 1.2 Available from www.adlnet.org

IMS

IMS Metadata v1.2.1. Available from http://www.imsproject.org/metadata/index.cfm

IMS Content Packaging Version 1.1.3. Available from http://www.imsglobal.org/content/packaging/index.cfm

IMS Question & Test Interoperability. Available from http://www.imsglobal.org/question/index.cfm

IMS Simple Sequencing Version 1.0. Available from http://www.imsglobal.org/simplesequencing/index.cfm

IMS Digital Repositories Specification. Available from http://www.imsproject.org/digitalrepositories/index.cfm

The Le@rning Federation

Educational Soundness Specification Version 2.2. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/educational_soundness_specification_v2_2.pdf

Rights Management Specification Version 1.2. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/rights_management_specification_v1_2.pdf

Accessibility Specification Version 1.5. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Accessibility_Specification_V1_5.pdf

Technical specifications for content development Version 3.0. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Tech_Specs_Content_Develop_V3_0.pdf

Metadata Application Profile Version 1.2. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Application_Profile_1_2.pdf

Metadata Application Profile Mandatory Elements Version 1.1. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Mandatory_Elements_1_1.pdf

Web Service Specification Version 0.4. Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/SOAP_Specification_V0_4.pdf

EdNA

EdNA Metadata Standard Version 1.1. Available from http://www.edna.edu.au/metadata/documents/edna_metadata.pdf

Appendix B Recommended reading

Advanced Distributed Learning 2002, *The SCORM Implementation Guide: A Step by Step Approach,* Advanced Distributed Learning available online at http://www.adlnet.org

Advanced Distributed Learning 2003 *Sharable Content Object Reference Model (SCORM™) Version 1.2 Conformance Requirements* Advanced Distributed Learning Inc http://adlnet.org/index.cfm?fuseaction=rcdetails&libid=285&bc=false

Carnegie Mellon University 2003, *SCORM Best Practices Guide for Content Developers,* Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, available online at http://www.lsal.cmu.edu/lsal/expertise/projects

Carnegie Mellon University 2003, *Content Developers' Guide to Simple Sequencing*, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, available online at http://www.lsal.cmu.edu/lsal/expertise/projects

IMS Global Learning Consortium 2003, *IMS Digital Repositories Core Functions Best Practices and Implementation Guide,* IMS Global Learning Consortium, Inc available online at http://www.imsglobal.org/digitalrepositories/driv1p0/imsdri_infov1p0.html

MASIE 2003, *Making Sense of Learning Specifications & Standards: A Decision Makers Guide to their Adoption,* The MASIE Center e-Learning CONSORTIUM available online at http://www.masie.com/standards/s3_2nd_edition.pdf

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http://www.imsglobal.org/content/packaging/index.cfm

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Peter Higgs	TAFE Tasmania
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Jill Jamieson	Challenger TAFE
Dennis McNamara	AEShareNet
Kerry Munston	TAFE Queensland
Dan Nicholas	EdNA Online Project
Gary Putland	education.au.edu.au
Simon Sinnot	The Learning Federation
Ralph Wirski	Edith Cowan University

This report has been researched and written by WestOne

For more information on the Australian Flexible Learning Framework contact:

Framework Communications Team
Phone: (07) 3225 3544
Fax: (07) 3237 0419
Email: aaron.snell@det.qld.gov.au