Learning Resource Metadata Initiative (LRMI) – RFP Guidance

SLC Project Document
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Change Log

Date	Version	Name	Change Summary
12/16/11	V1	EFloyd	Initial draft submission to SLC
1/13/12	V2	EFloyd	

Table of Contents

1. Introduction

This document is part of a series of documents that contain specifications for application software and system procurement where integration with SLI technologies is required. This *Draft Document* provides a draft view of a future SLC released document and is intended to be referenced in vendor RFPs. As of this writing, the SLI standards are still in development. The technical information in this document should be considered preliminary.

This document provides specifications for alignment of applications with the Learning Resource Metadata Initiative (LRMI).

1.1. Structure of Document

The draft specification is divided into five sections:

- **Overview** – Provides a broad description of the SLI technology upon which the requirements are based, including use case summaries.
- **Integration Approach** – Describes one or more approaches for integrating with a core SLI technology.
- **Configuration Options** – Discusses areas of potential configurability.
- **Standards and Technologies** –Identifies applicable standards and technologies and specifies their applicability to this standard. This section also identifies related projects, initiatives, and organizations.
- **Constraints** – Specifies constraints and exclusions that a proposed solution must satisfy.

2. Overview

This section provides an overview of the LRMI.

2.1. What is the Learning Resource Metadata Initiative?

The Learning Resource Metadata Initiative (LRMI) is a project led by Creative Commons (CC) and the Association of Educational Publishers (AEP) to establish a common vocabulary for describing learning resources. The vocabulary will be the first independently developed industry-specific framework addressing education that is designed to work with schema.org, the web metadata framework launched June 2, 2011 by Google, Bing, and Yahoo!, thereby improving the practical search and discovery of learning resources online. A common framework for tagging and organizing learning resources can enable further applications; thus, in order to maximize buy-in and the realization of future benefits for all learners, interoperability and transparency will be key criteria for the vocabulary and LRMI's development process.

The LRMI vocabulary is also intended for use with other metadata frameworks. For example, LRMI is expected to be used with Learning Registry.

More Information	Source Site
Learning Resource Metadata Initiative	http://www.lrmi.net/ and http://wiki.creativecommons.org/LRMI
LRMI Use Cases	http://www.lrmi.net/technical-info/use-cases
Schema.org Tagging Standards	http://schema.org/
Overview of LRMI (EdTech article)	http://www.edtechmagazine.com/k12/article/2011/08/frame-of-reference.
LRMI Draft Specification	http://wiki.creativecommons.org/LRMI/Properties
LRMI Current Discussion	http://groups.google.com/group/lrmi?pli=1

2.2. The Objective

The overall objective of the LRMI is to improve end-user search and discovery of learning resources. The goal for this project is to create a lightweight vocabulary that sits on top of existing tagging schema. To do this successfully, the LRMI framework will be based on extensive research of existing schema, and will likely use some of the same vocabulary.

The initiative's Technical Working Group and Advisory Group have gathered use cases from organizations with a stake in the online discoverability of learning resources.

2.3. Use Case Summaries

Selected use case summaries are provided below in order to facilitate a general understanding of the LRMI's intended impact.

Title	Summary
Educator plans a lesson that accommodates multiple instructional strategies	Educator uses search interface to exercise search services that pull instructional resources from the search database that are aligned to the search criteria. Search criteria include common core or state standards to be addressed and pedagogy in mind. Resources have been previously tagged to facilitate search.

Title	Summary
Publisher parses large instructional resource so the components can be referenced within a Dynamic Learning Environment (DLE)	The publisher selects an instructional resource to reference within the DLE. Using the meta-data system, the resource is broken into hierarchical components, each with required data and list of pieces. Using the data asset management system, the publisher links the actual content to the meta-data. The publisher pushes the content and meta-data to the DLE. (School administrators can now link to and/or enable the new instructional resources if they have rights. Publishers can track which components are used by which customers and how frequently.)
Search for instructional resources to support a personal learning goal	Student uses search interface to exercise search services that pull instructional resources from the search database that are aligned to the student's search criteria and the student profile/preference settings.
Curriculum specialist identifies effective resources	Curriculum specialist uses search interface to explore content marketplace(s) locating resources which are aligned to their search criteria and within their purchasing authority. (Search criteria include relevant standards, effectiveness metrics, type of resource, and other metadata. Search service is capable of federating with multiple content marketplaces.)

3. Integration Approach

Creative Commons has published a draft of the LRMI specification for comment here: http://wiki.creativecommons.org/LRMI/Properties.

The draft includes a description of the semantics of each term, where it fits within existing schema.org terms, and markup examples for many of the new terms. The following information is provided under the assumption that the reader is familiar with the material in the draft specification.

3.1. Relationship to Other Standards and Technologies

LRMI makes use of and facilitates the use of the following standards and technologies.

3.1.1. Common Core Standards

The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that young people need for success in college and

careers. Core standards currently exist for K-12 English Language Arts, and K-12 Mathematics. As of this writing, these standards have been adopted by 48 states and territories. More information on Common Core Standards can be found at http://www.corestandards.org/.

Each Core Standard element is tagged with a structured identifier. An example from 8th grade geometry is:

> 8.G.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Another from high school geometry is:

> G-CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

Note that the tags provide information on the grade level, subject area, and provide a unique identifier for the standard but provide no information on dependency relationships, such as pre-requisite competencies.

The Common Core State Standards Group is defining canonical URLs for each standard. For example:

> http://corestandards.org/the-standards/mathematics/grade-7/ratios-and-proportional-relationships/#7-rp-2[1]

In addition to pointing at the particular standard, a canonical URL is also human readable and represents the hierarchical organization of the standard. People involved in standardizing the URLs have indicated that this is in preparation for metadata embedded in learning content that references the standards.

In the sections that follow, we will use the generic term, “Learning Objective” as a synonym for “Core Standard”, “State Standard”, “Skill”, or “Competency”.

3.1.2. State Standards

The Common Core provides standards for K-12 English Language Arts and Mathematics only, and adoption is not mandatory. Individual states that have adopted the Common Core standards supplement these with standards for areas not covered by the Common Core. For instance, Georgia Social Studies 8th grade standards include:

> SS8E1 The student will give examples of the kinds of goods and services produced in Georgia in different historical periods.

Note that the identifier follows the pattern of the Common Core identifiers and that there is similarly no information on dependency relationships.

LRMI requires that state standards be referenced by a Uniform Resource Identifier (URI), which may be a LOI, as described in the next section, or a URL. Therefore,

[1] The example provided links to the indicated standard, but it is not a Common Core standard canonical URL. As of this writing, the canonical URLs have not yet been released. Canonical URLs are expected to be released by the NGA and CCSSO in early 2012 along with a standard machine-readable format with guidebooks that describe the proper way to align content to the common core and specific references to LRMI.

alignment to LRMI may require some state educational standards groups to define canonical identifiers for those standards not covered by the Common Core. Thus, Georgia, for example, might either add a prefix to their identifier (i.e. http://statestandards.ga.us/SS8E1) or use the identifiers assigned by the Achievement Standards Network (e.g. http://purl.org/ASN/resources/S113AA9B).

3.1.3. Learning Objective Identifiers

In support of the Common Core Standards, the Bill and Melinda Gates Foundation is sponsoring the development of a recommendation for a standard set of "Learning Objective Identifiers" ("LOIs") to be used to identify learning objectives for all SLI-related standards. This initiative is the subject of another *Draft Specification* document. Work on the recommendation is still in progress. The intent is for an LOI to be a registry-enforced, standard, machine-parseable identifier. Potentially, this could take the form of

loi:prefix/standard-id

where "prefix" will be a semantically insignificant ("opaque") identifier assigned by the Registry to the LOI Issuer, and "standard-id" will be the LOI Issuer's identifier, using any convention of their choice. For instance, a Core Standard might be represented by:

loi:B393-33/Common-Core/ELA/RL.3.1

where "B393-33" is the prefix assigned by the Registry and "Common-Core/ELA/RL.3.1" refers to English Language Arts (ELA), Reading and Literature (RL), Grade 3, standard #1. The standard ID in this example is not directly "de-referenceable", that is, the content of the standard cannot be accessed directly from its identifier. The LOI Registry would provide a web service that enables LOIs to be de-referenced. For example:

loi:493920/ Common-Core/ELA/RL.3.1

may be represented by

http://loi.gates.org/ Common-Core/ELA/RL.3.1

This web service may, in turn, redirect the browser to the actual content hosting location, which, as of this writing, is:

http://www.corestandards.org/the-standards/english-language-arts-standards/reading-literature/grade-3/#rl-3-1

This approach has the advantage of establishing a permanent identifier that remains stable and still provides a straightforward way to browse the content regardless of where that content is hosted in the future.

In a complex learning environment, we will need identifiers for many elements beyond Learning Objectives. These will include Learning Resources, Assessment Resources, Learning Paths, Curriculum Elements, and elements within Learning Resources such as Chapters, Goals, etc. The LOI recommendation is sufficiently general and flexible that it may trivially be extended to cover any such potential future application. Similarly, multiple versions of any of these elements may be handled very simply using the LOI recommendation.

As of this writing, it appears that the Common Core group has not followed this recommendation, choosing instead to define URLs for each of the standards. Many

states, however, will have an opportunity to assign URIs to their standards, as mentioned above. LOIs would certainly qualify and would provide advantages over URLs. Document Object Identifiers (DOIs), Extensible Resource Identifiers (XRIs) linked by XRI Data Interchange links (XDIs) or conventional URLs would qualify as well.

3.2. Learning Maps

While the organization of the Core Standards by subject and grade level provides a broad structure, dependencies at the detail Objective level are not expressed in the existing standards content. A Learning Map provides an organizing framework that maps the relationship between learning objectives, including dependencies and higher level groupings. A given curriculum will specify a path through the Learning Map, and a suite of tools will allow authoring and visualization of the Learning Map.

The Gates Foundation has awarded Applied Minds, LLC ("AM") a contract to design the Learning Map, implement its authoring and visualization tools, and develop related metadata specifications. In a parallel, internally-funded effort, AM will design and implement an API server.

The Core Data Model of the Learning Map is currently under development using an AM in-house database technology that is compatible with Metaweb Query Language (MQL), which is supported by Google and will provide a sharable API.

The operative metaphor for the Learning Map is Google Maps. The intent is for the visualization tools to allow a teacher, for example, to annotate the map with the equivalent of "points of interest" and "travel directions" that highlight specific learning objectives, resources, curriculum elements, and pathways relevant to a lesson plan or a student's individual learning plan.

This initiative is the subject of another *Draft Specification* document.

3.3. Integration Approach by Vendor Category

LRMI integration requirements vary by vendor category. The following vendor communities constitute the primary audience for this specification.

3.3.1. Content Publishers

The primary requirement of LRMI for content publishers is to use LRMI standard terms to markup web content. Since the LRMI metadata standard is a schema.org extension, the guidelines provided in http://schema.org/docs/gs.html for adding schema.org metadata markup to web content apply to the LRMI metadata standard as well. For example, the three essential LRMI metadata properties required for the Learning Map are:

teachesCompetencies - The competency, learning standard, and/or skill that the work teaches.

Example markup:

```
<div itemscope itemtype="http://schema.org/Book">

<link itemprop="url" href="http://example.com/IntroSDM.html" />
<span itemprop="name">Introduction to Single Digit
Multiplication</span>
by <a itemprop="author" href="/author/JohnDoe.html">John Doe</a>.

<div itemprop="teachesCompetencies" itemscope
itemtype="http://schema.org/Competency">
This book teaches <a itemprop="url"
href="http://purl.org/ASN/resources/S114347D">
<span itemprop="name">single digit multiplication</span></a>
```

requiresCompetencies - The competency, learning standard, and/or skill that the work requires the user to already have.

Example markup:

```
…
<div itemprop="requiresCompetencies" itemscope
itemtype="http://schema.org/Competency">
This book requires <a itemprop="url"
href="http://purl.org/ASN/resources/S114314C">
<span itemprop="name">multi-digit addition with
carry</span></a></div>
```

Assesses Competencies - The competency, learning standard, and/or skill that the work assesses.

Example markup:

```
…
<div itemprop="assessesCompetencies" itemscope
itemtype="http://schema.org/Competency">
This online resource assesses <a itemprop="url"
href="http://purl.org/ASN/resources/S114347D">
<span itemprop="name">single digit
multiplication</span></a></div>
```

(Note: the terms and syntax are likely to change based on some of comments being received by the LRMI committee. This document will be revised when those changes published.)

3.3.2. Content and Metadata Management Tool Providers

The primary integration approach for content and metadata tool providers is to enable the use of LRMI standard terms to markup web content. Since the LRMI metadata standard is a schema.org extension, the guidelines provided in

http://schema.org/docs/gs.html for adding schema.org metadata markup to web content apply to the LRMI metadata standard as well. Tool providers should enable and facilitate Content Publishers in their efforts to provide rich metadata markup for published learning resource content.

3.3.3. Search and DLE Tool Providers

The primary integration approach for search and DLE tool providers is to enable the use of LRMI search terms as filters. This is likely to come naturally as a side-effect of providing support for schema.org and its extensions.

Examples of possible searches that take advantage of Learning Resource Metadata include[2]:

> teachesCompetencies:S114347D & itemType:Book (all books that teach the indicated LOI)
>
> S114347D:requiresCompetencies* (all prerequisites to the indicated LOI)
>
> S114347D:assessesCompetencies & itemType:online (all potential online assessments for the indicated LOI)

4. Configuration Options

Areas of potential configurability include:

Area	Potential Configuration Items
Metadata Management tool Content Management tool Digital Asset Management tool Content authoring tool	Configure metadata schema sources Associate default metadata schema with content type Prioritize tag lists Remember previous tag assignments Select core or state standards sources
Search tool	Select metadata schema sources Validate search terms against schema Select core or state standards sources

[2] These queries are provided for illustrative purposes only. They are not intended to represent any specific query language syntax.

5. Standards and Technologies

The following standards and technologies are applicable to this specification:

Standard / Technology	Applicability
HTML5 (http://dev.w3.org/html5/html4-differences/)	Supports schema.org – based mark-up with MicroData
MicroData (http://www.w3.org/TR/microdata/ also http://dev.w3.org/html5/md/)	This mechanism allows machine-readable data to be embedded in HTML documents in an easy-to-write manner, with an unambiguous parsing model. This is the selected representation standard for LRMI terms.
RDF (http://www.w3.org/RDF/)	RDF is a standard model for data interchange on the Web. This is a competing representation standard for schema.org terms. Initial versions of LRMI will be published in RDF as well as MicroData.
MQL (http://wiki.freebase.com/wiki/MQL_Manual)	Metaweb Query Language – Query language developed for FreeBase and supported by Google.

5.1. Related and Affiliated Efforts

Initiative / Project / Organization	Applicability
schema.org (http://www.schema.org/)	Base structure for LRMI terms
Learning Registry (http://www.learningregistry.org/)	Working with LRMI to build a common vocabulary
Open Learning Initiative (http://oli.web.cmu.edu/openlearning/)	On-line course content
Dublin Core (http://dublincore.org/)	Prior work on standard terms
Association of Educational Publishers (http://www.aepweb.org/)	Co-manager of the LRMI
Creative Commons (http://creativecommons.org/)	Co-manager of the LRMI
Common Core Standards (http://www.corestandards.org/)	Motivation for adding competency-related terms
XRI Data Interchange (http://www.xdi.org/)	Alternative URI type for standards
Digital Object Identifier (http://www.doi.org/)	Pattern for LOI recommendation

6. Constraints

To be compliant with this specification, solutions will be subject to the following constraints.

None Known