A Practical Introduction to SCORM – Part 1

Details of SCORM - Overview

02 – April - 2006

Robby Robson
robby@computer.org
Topics – Part 1

- History
- What problems SCORM solves
- Assumptions SCORM makes
- The books (and parts) of SCORM
Many slides in this presentation were produced by and used with permission of the Advanced Distributed Learning initiative (www.adlnet.org).

Others were reused / repurposed from previous workshops and presentations.
SCORM = Sharable Content Object Reference Model

SCORM means SCORM 2004 (3rd edition)
ADL Timeline

- Nov. 97, White House Co-sponsors ADL Kick-off Meeting
- Jan. 98, Executive Memo citing ADL as a model for federal agencies
- Apr. 99, Opened the ADL Co-Lab in Alexandria, VA
- May 00, Implementation Plan submitted to Congress
- Jun 01, Executive Order 13218 21st Century Workforce Initiative
- Jan. 04, SCORM 2004 released
- Dec. 04, SCORM 2004 2nd Edition
- Jan. 99, Executive Order 13111 tasking DoD to lead collaborative standards development
- June 00, SCORM 1.0 released
- Feb. 04, International Plugfest, Zurich
- Feb. 05, Plugfest 9
A SCORM IS BREWING

SCORM 1.0 SCORM 1.1 SCORM 1.2

DIRECTIVE TO CREATE SCORM (13111)

1999 2000 2001 2002 2003 2004 2005

- Course Structure Format (XML Version of AICC Course Structure Files)
- Runtime API – developed jointly among AICC, IEEE, and ADL
- Metadata based on IMS Version 1.0

SCORM 1.3

- “C” is for “Content”
- Metadata Harmonized
- Bugs Fixed
- CMI Data Model Pared back (removed prerequisites and completion requirements)

SCORM 2004

- Added Content Packaging
- Deprecated Course Structure Format
- Created Test Suites
- Bugs Fixed

SCORM 2004 3rd Edition

- Simple Sequencing
- Metadata Harmonized
- Bugs Fixed
- Conformance program getting started

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WHAT IS SCORM?

- **A REFERENCE MODEL**: A set of profiles of standards and specifications that tells you how to do something useful
- **A SOLUTION**: Solves the problem of separating Web-based training content from delivery systems
- **A STANDARD**: Adopted by most commercial LMS products and required by a DoD directive
SCORM ASSUMES ...

- A particular content lifecycle (next slide)
- Web-based content
  - Interactive (optional)
  - Static (designed ahead of delivery)
- A single learner
- Progress by objectives
SCORM CONTENT LIFECYCLE

Adobe Products, MS Office, etc. → Learning Content Authoring Tools → Create Chunk → Assemble & Sequence

Existing Content → Repurpose → Find Learning Catalog

Track LMS → Deliver LMS → Import (Learning) Content Management System
A SET OF BOOKS
Content Aggregation Model
1. Learning Object Metadata (1484.12)
2. Content Packaging (IMS Specification)

Describe, export, transport and import

Run-Time Environment
3. Application Programming Interface (1484.11.2)
4. Data Model (1484.11.1)

Launch, track, communicate learner info

Sequencing & Navigation
5. IMS Simple Sequencing

Adaptive learning, instructional design
SCORM Content Aggregation Model

Content Package

Manifest (XML document)

<?xml version="1.0" encoding="UTF-8" standalone="no"?>

<metadata>
  <schema>ADL SCORM</schema>
  <schemaversion>1.2</schemaversion>
  <lom xmlns="http://www.imsglobal.org/imsd_rootv1p2"/>
</metadata>

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SCORM Runtime Environment

**Data Model:**
Actual data sent back and forth between a SCO and LMS.

Communication with backend server is not specified in SCORM.

**API:**
Communications Link between a SCO and LMS

**Data Model:**
Data retrieved from and stored in the LMS from the SCO.
Activities are aggregated and organized into a tree.

A default traversal path can be modified by a learning designer.

Traversal is triggered by a sequencing request.

Request is triggered either by the learner through navigation events or by the delivery system.

Sequencing rules are evaluated at runtime and can be conditional.

Activities are delivered one at a time.

Actual content resides in leaves of the tree.
Remediation Using Objectives

Rule: Exit if Obj_1 AND Obj_2 are Satisfied. Else, Continue.

Rule: Skip Lesson 1 if Obj_1 is Satisfied

Rule: Skip Lesson 2 if Obj_2 is Satisfied

Rule: Set Satisfaction Status for Obj_1

Rule: Set Satisfaction Status for Obj_2
Remediation Using Objectives

Module 3

Lesson 1

Lesson 2

Assessment

Learner experiences Lessons 1 and 2 then takes Assessment

Test Item 1

Test Item 2

Obj_1

Obj_2

Learner Fails Test Item 1

Learner Passes Test Item 2

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Remediation Using Objectives

Module 3

Lesson 1

Lesson 2

Assessment

Assessment sets
Satisfaction Status for Obj_1 and Obj_2

Learner Failed Test Item 1

Test Item 1

Learner Passed Test Item 2

Test Item 2

Objectives

Obj_1

Obj_2
Remediation Using Objectives

Rule: Exit if Obj_1 AND Obj_2 are Satisfied. Else, Continue

Rule: Skip Lesson 1 if Obj_1 is Satisfied

Rule: Skip Lesson 2 if Obj_2 is Satisfied

Eduworks Corporation

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<xml version="1.0" encoding="UTF-8"/>
<!--This is a Reload version 1.1.1 SCORM 2004 Content Package document-->
<!--Spawned from the Reload Content Package Generator - http://www.reload.ac.uk-->
http://www.imsglobal.org/xsd/imsss imsss_v1p0.xsd http://www.adlnet.org/xsd/adlseq_v1p3 adlseq_v1p3.xsd
http://www.adlnet.org/xsd/adlnav_v1p3 adlnav_v1p3.xsd" version="1.3">
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<title>Retry Aggregation</title>
<item identifier="ITEM-A0BAB980-6C55-EF4A-6080-D73FFB8D9B32" identifierref="RES-592A8E69-7EB7-B001-4F69-50C13209E942">
<title>SCO-1 Lesson</title>
<imsss:sequencing>
<imsss:controlMode choice="true" choiceExit="true" flow="false" forwardOnly="false" useCurrentAttemptObjectiveInfo="true" useCurrentAttemptProgressInfo="true" />
<imsss:sequencingRules>
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<imsss:ruleConditions conditionCombination="all">
<imsss:ruleCondition operator="noOp" condition="satisfied" />
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<imsss:ruleAction action="skip" />
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<title>SCO-2 Lesson</title>
</item>
</metadata>
</manifest>
Example: Content Created in a SCORM Authoring Tool
Content exported to a SCORM package

Type of content package to export

Export destination

SCORM 1.2 Conformant
SCORM 1.0 Conformant
SCORM 1.1 Conformant
SCORM 1.2 Conformant

Destination Folder:

- Publish Only Updated Pages/Resources
- Publish All Pages/Resources in the Title

Store Published Title in a Zip File
Create ALT Tags for Images and Buttons
Include Title Manager

NSDL Reusable Learning

Additional Keywords:

The published course will report Question and Test interactions to the Learning Management System (LMS).
The published course will prompt to restore the last viewed location within the Learning Management System (LMS).
Exported Content as a SCORM Package
Sign on to LMS and Import Content

- search content
- Administration
- Content Display Settings
- Manage Files
- Manage Content
- Add Module
- Add Topic
- Import Course
- Scorm Reporting
NSDL Content Reusability

NSDL Reusable Learning

Pre Test
Reusability Framework
Content Model

Welcome
Student (GC), Demo
### Status, Score, Accesses, Time – Sent to LMS

#### Summary Information - Total (and %) of SCO's in Each Status Type

<table>
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<tr>
<th>Status</th>
<th>Total</th>
<th>Percentage</th>
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<tr>
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<tr>
<td>COMPLETED</td>
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<td>50.00%</td>
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#### Single User Single Course for DEMO STUDENT (GC)

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<th>Completed</th>
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<th># Accesses</th>
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Summary

Historical Link … http://www.rhassociates.com/scorm.htm

- 5 parts of SCORM
  - Metadata (IEEE Standard)
  - Content Aggregation (IMS Specification)
  - Runtime Environment (IEEE Standards)
    - CMI Data Model
    - JavaScript API
  - Sequencing & Navigation (IMS Specification)
- Lots of functionality
- But how does it work??? Stay tuned ...
A Practical Introduction to SCORM – Part 2

Details

02 – April - 2006

Robby Robson
robb@ccomputer.org
Topics – Part 2

- Metadata
- Content Aggregation
- Runtime Environment
- Sequencing and Navigation
Principles

- Metadata is ...
  - An *assertion* about a resource
  - Not unique
  - Often subjective

- Metadata is for
  - Search & Discovery
  - Cataloguing
  - Describing resources
  - Processing resources
  - Adding *context* to resources
Perspectives

- Metadata standards are for communicating with arm’s length partners
- The value of metadata is a network effect
- Pedagogical metadata for learning systems
- Rights for distributed systems
- Both for distributed learning
- Full text search is very effective*

* For text-based documents
Practicalities

- “Forms must Die” (AMG is key)
- Not required = not supported
- Requirements on systems are not the same as requirements on instances
- The network effect:
  - LMS ignore it
  - Repositories use it
  - Federations require it (CORDRA)
LOM Categories

- **General:** Descriptive information.
- **Life Cycle:** Provenance and current state
- **Meta-metadata:** About the metadata record itself
- **Technical:** Technical requirements and characteristics
- **Educational:** Pedagogical characteristics / intent
- **Rights:** Copyright and usage conditions
- **Relation:** Relationship to other resources
- **Annotation:** Comments
- **Classification:** Properties not specified above – classified using taxonomies
LOM is structured Metadata

Example: **SCO.XML**

*Courtesy ADL Academic Co-Lab*
LOM Concepts

- Identifiers
  - Catalogue
  - Entry
- Langstrings
- Smallest Permitted Maximum (SPM)
- Controlled vocabularies
- Obligation
- Profiling Mechanisms
  - Changes in obligations (e.g. SCORM)
  - Additional vocabularies (non-conflicting)
  - Additional elements (non-conflicting)
SCORM 2004 LOM Requirements

- Five levels of metadata
  - Content Aggregation Metadata
  - Activity Metadata
  - SCO Metadata
  - Asset Metadata

- Metadata is optional
- Metadata has mandatory fields if used. (See next slide)
- Changes in SCORM 2004 Edition 3
## SCORM 2004 (V2) Obligatory Elements (if metadata used)

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<th>Package</th>
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<th>Asset</th>
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<td>6.2 Copyrights and Other Restrictions</td>
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</table>
Metadata in Authorware

![Image of Authorware Metadata Editor]

This is the pedagogical information essential to those involved in achieving a quality learning experience. The audience for this metadata includes teachers, managers, authors, and learners.

User(s): [ ] Teacher [ ] Author [ ] Learner [ ] Manager

Interactivity: [ ] Difficulty: [ ] Semantic Density: [ ]

Duration: [hh:mm:ss]

Language: [ ] Select:


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Metadata in Lectora and Dreamweaver

![Publish SCORM Location dialog box](image)

- **FTP Options**: SCORM Options
  - Course ID: SCORM 1.2 Conformant
  - Course Creator: SCORM 1.1 Conformant

- **Proxies**: SCORM Options 2
  - Publish Location

- **Cisco CDN**:

**Table of Contents**
- Resource
- Type

**Keywords**:
- Only selected launch resources will be included in the Table of Contents.

**XML Control Documents**
- Copy XDP Files to Site:
  - Use XDP files from Local Drive
  - Get XDP files from ADL Site

**Manifest Maker**
- Creates ADL SCORM 1.2 Packaging Manifest
CONTENT AGGREGATION
Content Package

The manifest file is required to be called imsmanifest.xml – this is a good way to look for IMS content packages!

Academic Co-Lab Example
(Minimal Content Package)

Saba SCORM Detective
(More typical Content Package)
Content Packaging Details

- **Resource Content Package** – for transporting files
- **Content Aggregation Content Package** – for defining / transporting SCOs (including sequencing and navigation)

<table>
<thead>
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<th>No.</th>
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<th>Resource Content Package</th>
<th>Content Aggregation Content Package</th>
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### Content Packaging Details

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</tbody>
</table>
Content Packaging Notes

- Sub-manifests: Not recommended in SCORM 2004 Edition 3
- References can be to files in the package or external files (through a URL)
- All physical files should be declared (using <file> element)
- Un-packing requires working local references
Interoperating in the Larger World

- There ARE other metadata standards and specifications and standards
  - Dublin Core

- There ARE other content aggregation specifications and standards
  - MPEG 21 Part 2
  - METS

- There ARE systems that use IMS Content Packaging but do not use SCORM
RUNTIME COMMUNICATION
Runtime Conceptual Model

Content Repository / Learner Data

Learning Management System (LMS)

Data Model Info

Run Time Service (RTS)

Data Model Info

LMS

Content repository / Learner data

API Instance

Run Time Environment

API Calls

Results from API Calls

Learner Interaction

Content Object

Learner Interaction

Content Object
API Finder Example

SCO Functions Example

LMS

API Object supplied by LMS instantiates functions

Frame climbing code finds API Object

Initialize
Terminate
Commit
GetValue
SetValue
GetLastError
GetErrorString
GetDiagnostics

HTML with JavaScript functions in a frameset
Runtime Data Model

- **Learner Information**
  - Learner_id
  - Learner_name
  - Learner_preference
  - Comments_from_learner

- **Launch Information**
  - Location (e.g. URL)
  - Comments_from_LMS
  - Max_time_allowed
  - Mode (e.g. credit, browse)
  - Launch_data
  - Suspend_data
  - Entry (ab_initio, resume, _nil_)
  - Exit (timeout, suspend, logout, normal, _nil_)

- **Pedagogic Data**
  - Objectives
  - Progress_measure (0 to 1)
  - Scaled_passing_score [-1.0,1.0]
  - Score (scaled, raw, min, max)
  - Success_status (passed, failed, unkown)
  - Completion_status (completed, incomplete, not_attempted, unknown)
  - Completion_threshold
  - Credit (credit, no credit)
  - Session_time
  - Time_limit_action (what to do)
  - Total_time
  - Interactions [Next Slide]
Interactions

- **Type:** T/F, FIB, etc.
- **Objective_IDs** Objectives associated with interaction
- **TimeStamp** Time when first available
- **Correct Responses** Correct response pattern
- **Weighting** For “roll up”
- **Learner Response** Actual response
- **Latency** Time between availability and first response
- **Result** Evaluation of correctness

*This is different from the QTI model!*
Boeing Presentation from February: Using SCORM to Store Student Interactions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Desired</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Runway</td>
<td>True if touched down on runway</td>
<td>true</td>
<td>false</td>
</tr>
<tr>
<td>Wire Caught</td>
<td>Which wire was grabbed (0 if none; 1—closest to leading edge, 2=last wire)</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Air Speed</td>
<td>Speed at touchdown (keas)</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>Glide Slope</td>
<td>Flight path at touchdown (deg)</td>
<td>-5</td>
<td>-4</td>
</tr>
<tr>
<td>Distance From Target</td>
<td>Miss distance from ideal (ft)</td>
<td>0</td>
<td>-941.3</td>
</tr>
<tr>
<td>Heading Error</td>
<td>Angle off runway heading (deg)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dive Rate</td>
<td>Dive rate at touchdown (ft/min)</td>
<td>1200</td>
<td>734</td>
</tr>
<tr>
<td>Flaps Down</td>
<td>True if flaps were down at touchdown</td>
<td>true</td>
<td>true</td>
</tr>
<tr>
<td>Gear Down</td>
<td>True if gear was down at touchdown</td>
<td>true</td>
<td>true</td>
</tr>
</tbody>
</table>

SetValue(cmi.interactions.0.id, onRunway)
SetValue(cmi.interactions.0.type, performance)
SetValue(cmi.interactions.0.time, 13:54:54.66)
SetValue(cmi.interactions.0.latency, 00:02:15.88)
SetValue(cmi.interactions.0.correct_responses.0.pattern, true)
SetValue(cmi.interactions.0.student_response, false)
SetValue(cmi.interactions.0.result, wrong)
SetValue(cmi.interactions.1.id, wire)
SetValue(cmi.interactions.1.student_response, 0)
SetValue(cmi.interactions.2.id, speed)
SetValue(cmi.interactions.2.correct_responses.0.pattern, 125)
SetValue(cmi.interactions.2.student_response, 0)
SetValue(cmi.interactions.2.result, wrong)
SetValue(cmi.interactions.3.id, flightPath)
SetValue(cmi.interactions.3.student_response, -4)
SetValue(cmi.interactions.4.id, missDistance)
SetValue(cmi.interactions.4.student_response, -941.3)
Sequencing and Navigation
SCORM 2004 – IMS SIMPLE SEQUENCING

- Activity Tree
  - Activities can contain learning resources and other activities
  - Each activity has unique identifier within tree
  - Maps to *items* in Content Packaging

- Navigation triggered by *navigation requests*
  - Applies to whole tree or *clusters*.
  - *Clusters* have one level of children, but children could be clusters
  - Default behavior is *choice* (user chooses)
  - *Flow* defines linear or adaptive sequencing
  - *Forward only* prevents “previous” behavior

- State Model
  - Maintained by LMS (RTS)
  - Includes *completion status, duration* and *objectives* associated with activities and with each *attempt* at an activity
  - Objectives have *status* and *measure*. (Completion versus a score.)

- Objectives
  - Objectives are local or global
  - Activities can affect and use multiple objectives
Simple Sequencing Conceptual Model

Overall Sequencing Process
- Navigation Behavior
  - Exit Request
- Exit Behavior
- Rollup Behavior
- Selection and Randomization Behavior
  - Sequencing Request
  - Sequencing Behavior
  - Delivery Request Behavior

Navigation Event (e.g., Continue, Previous, Choose, Exit, etc.)

Learner Info
- Status of Lessons
- Mastery Status
- Persistent Time
- Etc.

SCORM Communication
- Runtime Data Communication
- Runtime

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Typical Activity Tree

Module A

LESSON 1

PRETEST

INSTRUCTION ACTIVITY

ASSESSMENT

LESSON 1 CONTENT 1

LESSON 1 CONTENT 2

LESSON 1 CONTENT 3

REMEDIATION ACTIVITY IF NEEDED

Instruction Activity is Parent for a Cluster

These launch SCOs or Assets

Module B

LESSON 2

Cluster

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Sequencing Model Parts

- Navigation Requests and Actions
- Sequencing
- Objectives
- Tracking
- Rollup
- Auxiliary Resource
Navigation Requests

- Triggered by environment or content
- Allowable Requests:
  - Start
  - Resume All
  - Continue
  - Previous
  - Choice
  - Exit
  - Exit All
  - Suspend All
  - Abandon
  - Abandon All
- If LMS issues a continue, previous or choice request while an activity is being attempted, it causes an exit.
Sequencing: Control Modes

- Choice (Table of Contents)
- Flow (Linear Progression)
- Forward Only
- Exit
Sequencing: Limit Conditions

- Attempts
- Duration
  - Attempt Absolute Duration
  - Attempt Experienced Duration
  - Activity Absolute Duration
  - Activity Experienced Duration

- Availability Time
  - End
  - Begin
Sequencing: Selection and Randomization of Child Activities

- Can select a given number of child activities
- Can randomize order of child activities
- Selection or Randomization can be applied
  - Never (all child activities selected)
  - Once (first time attempted)
  - On each new attempt
Sequencing rules specify what action should occur under a particular condition.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Preconditions</th>
<th>Postconditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attempted</td>
<td>Objective Measure Known</td>
<td>Exit Parent</td>
</tr>
<tr>
<td>Objective Status Known</td>
<td>Objective Measure Greater Than</td>
<td>Exit All</td>
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<tr>
<td>Satisfied</td>
<td>Objective Measure Less Than</td>
<td>Retry</td>
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<tr>
<td>Activity Progress Known</td>
<td>Always</td>
<td>Retry All</td>
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<tr>
<td>Completed</td>
<td>Attempt Limit Exceeded</td>
<td>Continue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Previous</td>
</tr>
</tbody>
</table>

For example:

IF {Satisfied} THEN {Stop Forward Traversal}  
IF {Attempt Limit Exceeded} THEN {disabled}  

Two combinations of conditions allowed: all or any.
Sequencing rules specify what action should occur under a particular condition.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Precondition Actions</th>
<th>Postcondition Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attempted</td>
<td>Skip</td>
<td>Exit Parent</td>
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<tr>
<td>Objective Measure Known</td>
<td>Disabled</td>
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<td>Satisfied</td>
<td>Stop Forward Traversal</td>
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<tr>
<td>Activity Progress Known</td>
<td>Exit Actions</td>
<td>Continue</td>
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<td>Completed</td>
<td>Exit</td>
<td>Previous</td>
</tr>
<tr>
<td>Attempt Limit Exceeded</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example:

**IF NOT ALL {Satisfied} THEN {Retry All}**
Objectives

- “Learning objectives” but really just tokens
- Objectives are satisfied or not satisfied
- Objectives have normalized measures (-1 to 1)
- Global objectives are stored by LMS
- Local objectives are
  - Defined within an activity tree
  - Can point to global objectives via objective maps
  - Can read from and write to global objectives
- Objectives have minimum satisfied normalized measures for satisfaction.
- Objectives can be included or excluded from rollup
Objective Mapping

Objective 1 (global)
Status: Satisfied

Objective A1 (local)
Status: Satisfied

Objective B12 (local)
Status: Undefined

Objective:
MapInfo:
  TargetObjectiveID: 1
  WriteSatisfiedStatus: True
  ReadSatisfiedStatus: True

Objective:
MapInfo:
  TargetObjectiveID: 1
  WriteSatisfiedStatus: False
  ReadSatisfiedStatus: True
Tracking and State Model

- Sequencer must track
  - Activity Progress (duration, count)
  - Attempt Progress (duration, count, completion amount and completion status)
  - Objective Progress (satisfaction, normalized measure)

- Sequencer must maintain
  - Activity state
    - Current activity
    - Is an attempt being made in the current activity
    - All suspended activities
  - Activity available children
Tracking

ACTIVITY A

- Objective ID
  - (Globally Unique ID)
- Objective Satisfied by Measure
  - (True/False)
- Objective Minimum Satisfied Measure
  - [-1,1]
- Objective Contributes to Rollups
  - (True/False)

Defined in XML Sequencing Rules

Tracked by Runtime Environment

TRACKING MODEL

Objective Progress Information
- Satisfied Status (True/False)
- Normalized Measure [-1.0,1.0]

Activity Progress Information
- Absolute Duration (Duration)
- Experienced Duration (Duration)
- Attempt Count (Non-negative Integer)

Attempt Progress Information
- Completion Amount [0.0,1.0]
- Completion Status (True/False)
- Experienced Duration (Duration)
- Absolute Duration (Duration)
Roll-up

- Determines whether
  - An *objective* has been *satisfied*
  - An *activity* has been *completed*

- Child activities can contribute to values
- Child activities can be weighted
- Child activities can be excluded
- Satisfaction and completion can depend on a selected number of child activities being satisfied or complete
### Roll-up Rule Summary*

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Child Activity Set</th>
<th>Action</th>
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<td>Incomplete</td>
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<td>Activity Progress</td>
<td>At Least Percent</td>
<td></td>
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<tr>
<td>Known</td>
<td></td>
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<tr>
<td>Satisfied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attempt Limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exceeded</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example:

IF ANY {*Attempted*} THEN {*Completed*}

*From SCORM 1.3.2 Public Draft, February, 2006*
Roll-up Rule Summary*

For example:

**IF AT LEAST 3 \{Completed\} THEN \{Satisfied\}**

*From SCORM 1.3.2 Public Draft, February, 2006*
Roll-up Rule Summary*

For example:

IF NOT ALL \{Satisfied\}  THEN  \{Not Satisfied\}

*From SCORM 1.3.2 Public Draft, February, 2006
Rollup Rule: ChildActivitySet=All

AA: Satisfied

Rollup Rule
ChildActivitySet = All
RollupCondition = Satisfied
Action = Satisfied
Rollup Rule:
ChildActivitySet = AtLeastCount

Rollup Rule
ChildActivitySet = At Least Count
RollupMinimumCount = 2
RollupCondition = Satisfied
Action = Satisfied

AA: Satisfied
Building More Complex Combinations of Conditions

Desired: IF ((X and Y) or Z) THEN Hide from Choice

Desired: IF ((X or Y) and Z) THEN Skip

Flow Direction
Template 9: Basic Three-Way Branching

SCO-1
Choose A, Score = 0
Choose B, Score = 0.5
Choose C, Score = 1
Report Score to OBJ-1

SCO-2 (Show if A is chosen)
Read OBJ-1, then
If OBJ-1 Score > 0, Skip

SCO-3 (Show if B is chosen)
Read OBJ-1, then
If OBJ-1 Score < 0.5, Skip
If OBJ-1 Score > 0.5, Skip

SCO-4 (Show if C is chosen)
Read OBJ-1, then
If OBJ-1 Score < 1, Skip

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LSAL Template: Pre & Post-Test with Remediation

TEMPLATE 10: Pre- and Post-Test Sequencing With New Content for Remediation

- **Root Aggregation**
  - SCO-A Pre-Test
  - Aggregation-A
    - SCO-1 instruction
    - SCO-2 instruction
  - Aggregation-B
    - SCO-3 remediation
    - SCO-4 remediation
    - SCO-B Post-Test (mastery)
  - SCO-C Post-Test

- **Objectives**
  - OBJ-1
  - OBJ-2
  - OBJ-3
  - OBJ-4

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Auxiliary Resources

- Allows references to be included in activities (e.g., a manual)
- Behavior is out of scope
- *May play a role in integration with simulations*
Sequencing information can be associated with the organization and/or each item in the organization.
Design & Development
Effect of SCORM on Design / Development Process

- Changes little in the overall process (ADDIE)
- Requires awareness of
  - Reuse
  - Granularity
  - Communication possibilities
  - LMS / Content separation
- Adds time *initially*
- Is supposed to save time via reuse
- Is hopeless without tools
Real World Experiences

- LMS products do not all interpret SCORM the same way
- Issues include:
  - *Semantic* interoperability. E.G.
    - Interpreting scores
    - Metadata crosswalks
  - Not required = not supported
  - Implicit expected or undefined behaviors. E.G.
    - What happens to state data when you “walk off” an activity tree?
    - No requirement to reference files in manifest – how does the importing system know they are there?
Summary

- 5 parts of SCORM
  - Metadata (IEEE Standard)
  - Content Aggregation (IMS Specification)
  - Runtime Environment (IEEE Standards)
    - CMI Data Model
    - JavaScript API
  - Sequencing & Navigation (IMS Specification)
- Lots details
- Lots of functionality
- Some pitfalls
- Lots of tools??? Stay tuned ...
Topics – Part 3

- ADL provided tools
- Open source and commercial SCORM tools
- Conformance testing
- Adoption trends
ADL – Provided Tools

- Sample RTE
- RELOAD (demo)
- Conformance Self-test
- Lists of third-party tools
- ADL Prototype Projects
  - SCORE Prototype (→ XML SCORM Studio)
  - LSAL Design Templates
Open Source & Commercial Tools

- Types of tools:
  - LMS / LCMS
  - Authoring tools
  - Software libraries / SCORM “retrofitters”
  - Widgets
    - SCORM testers
    - API adopters

- Certified tools: See ADL site (www.adlnet.org)

Tools Links …

http://www.jointadlcolab.org/capabilities/pnplab/tools/
http://www.conform2scorm.com/

The appearance of a tool in this presentation does not constitute an endorsement, recommendation or warrantee of any type.
LMS / LCMS

- Open Source Examples
  - Moodle (SCORM 1.2)
  - Atutor (SCORM 1.2)
  - DotNetScorm (SCORM 1.2)

- Commercial Examples
  - Lots

- Status
  - Working well

- Caveats
  - Lack of competency management
  - Don’t do much with metadata
  - Content integration may still require tweaks
  - SCORM has inherent limitation
Authoring

- Open Source Examples
  - Atutor
  - ILIAS

- Commercial Examples
  - Lots
  - Many common Adobe tools (e.g. Dreamweaver™ / Authorware™ / Flash™)

- Korean Example (functionality explained)

- Status
  - OK

- Caveats
  - Metadata not automatically generated
  - Most don’t integrate with repositories or an LMS
  - Not that easy to use
Libraries & Retrofitters

- API Adapters – see ADL Site
- SCORM Players – see ADL Site
- Retrofitters
  - Rustici (software approach)
  - Recombo (middleware approach)
- Widgets – see ADL Site (e.g. SCORM Detective)
- Status
  - More and more of these
- Caveats
  - Can save time / effort but not magic bullets
  - May be unsupported software
  - May be interim solution
<table>
<thead>
<tr>
<th>TOOL (slide from ADL)</th>
<th>CONFORMANCE LABEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avilar’s WebMentor</td>
<td>SCORM 1.2 LMS</td>
</tr>
<tr>
<td>Blackboard</td>
<td>SCORM 1.2 LMS</td>
</tr>
<tr>
<td>Giunti’s Learn eXact</td>
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<td>Granada’s LearnWise</td>
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<td>Meridian’s KSI Knowledge Center</td>
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<td>OutStart’s Evolution LCMS</td>
<td>SCORM 1.2 LMS</td>
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</tr>
<tr>
<td>SumTotal’s TotalLCMS v. 7.0</td>
<td>SCORM 1.2 LMS</td>
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<td>D2L Learning Platform</td>
<td>SCORM 1.2 LMS</td>
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<tr>
<td>Meridian KSI v. 5.0</td>
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<td>Meridian’s Player v. 3.0</td>
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<td>Rustici Software’s SCORM Engine</td>
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<td>Techniques KnowledgeWorks</td>
<td>SCORM 2004 LMS</td>
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<tr>
<td>DCI’s MetaSoft Metadata Registry</td>
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<tr>
<td>HarvestRoad’s Hive – Repository</td>
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## Free and Open Source Tools (Slide from ADL)

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<tr>
<th>Tool</th>
<th>Search</th>
<th>LMS</th>
<th>MD Editor</th>
<th>SCORM CP</th>
<th>SCORM S&amp;N</th>
<th>Content Authoring</th>
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<tr>
<td>Reload 2004**</td>
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<td>Scormisizer*</td>
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<td></td>
<td>✔</td>
<td>✔</td>
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</tbody>
</table>

*Free, **Open Source*

---

Eduworks Corporation  
SCORM Tutorial  
02-Apr-06
SCORM Conformance / Certification

SCORM *conformance* can be claimed if a product
- Has passed the SCORM Conformance Test Suite (Self Test)
- Conforms to the latest version of SCORM as outlined in the SCORM Conformance Requirements

**Certification** requires independent testing:
- Wisconsin Testing Organization
  - Madison, Wisconsin
  - [www.witesting.org](http://www.witesting.org)
  - Process flow chart
- Naval Undersea Warfare Center (NUWC) Division Keyport
  - Keyport, Washington
  - [www.keyport.kpt.nuwc.navy.mil](http://www.keyport.kpt.nuwc.navy.mil)
  - [SCORM 1.2 RTE Certificate](#)
Is conformance / certification and interoperability guarantee?

- No
  - Tests do not have complete coverage
  - Some issues cannot be addressed. E.G.
    - Optional elements
    - Semantic interoperability
    - Undefined behaviors

- But Yes
  - Seeing fewer problems as time goes on
  - Often only minor tweaks required
Stabilization / Clarification / Issue Resolution (From ADL presentation)

SCORM 2004
January 2004

SCORM 2004 2nd Edition
July 2004

SCORM 2004 3rd Edition
XXX 2005

Time

Bug Fixes, Corrections & Clarifications

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## AICC & SCORM Adoption (April 2004)

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<thead>
<tr>
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<td>87%</td>
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<td>74%</td>
<td>56%</td>
<td>*</td>
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<td>Support Planned</td>
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<td>*</td>
<td>4%</td>
<td>0%</td>
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<td><strong>SCORM Support</strong></td>
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<td>72%</td>
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<td>63%</td>
<td>39%</td>
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<td>Other</td>
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<td>*</td>
<td>4%</td>
<td>9%</td>
<td>4%</td>
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<td>Support Planned</td>
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<td>7%</td>
<td>13%</td>
<td>5%</td>
<td>*</td>
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<tr>
<td><strong>No SCORM Exists / Planned</strong></td>
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<td>80%</td>
<td>10%</td>
<td>0%</td>
<td>23%</td>
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<td>IMS Metadata</td>
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<td>43%</td>
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<td>25%</td>
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<td>IMS QTI</td>
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<td>IMS (not specified)</td>
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<td>*</td>
<td>*</td>
<td>9%</td>
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</tr>
</tbody>
</table>
Adopters (From ADL presentation)

- **SCORM 1.2**
  - 134 Adopters

- **SCORM 2004**
  - 9 Adopters

- Adoption of SCORM 2004 is following the same pattern as happened with 1.2
Certified Products (from ADL presentation)

- SCORM 1.2
  - LMS: 47
  - Content: 25
- SCORM 2004
  - LMS: 2
  - Content: 0

Certification of SCORM 2004 is following the same pattern as happened with 1.2
Snap Shots From The Field

- The following are adopted from slides
  - Created by Paul Jesukiewicz (ADL CoLab Director)
  - Presented at International Plugfest 2
  - Based on data from latter part of 2005
<table>
<thead>
<tr>
<th>Service LMS Implementation</th>
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<tbody>
<tr>
<td><strong>Current</strong></td>
</tr>
<tr>
<td><strong>Army</strong></td>
</tr>
<tr>
<td>ALMS (Saba version 3.4.1)</td>
</tr>
<tr>
<td>ILMS (Aspen v 1.1 w/Build 7.0.1173)</td>
</tr>
<tr>
<td>Aspen v2.0</td>
</tr>
<tr>
<td>Core v2.3.8</td>
</tr>
<tr>
<td>Meridian KSI</td>
</tr>
<tr>
<td>Blackboard</td>
</tr>
<tr>
<td>mGen</td>
</tr>
<tr>
<td><strong>Navy</strong></td>
</tr>
<tr>
<td>THINQ</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Air Force</strong></td>
</tr>
<tr>
<td>No single LMS (currently 7)</td>
</tr>
<tr>
<td>Meridian KSI (9 out of 16 AF orgs)</td>
</tr>
<tr>
<td><strong>Marine Corps</strong></td>
</tr>
<tr>
<td>THINQ Training Server 4.6</td>
</tr>
</tbody>
</table>
SCORM Content Implementation

**Army**
- There are 43 fielded courses that are SCORM compliant; 13 SCORM v1.1 and 32 SCORM v1.2.
- There are 14 SCORM v1.1 compliant courses still under development and 107 SCORM v1.2 compliant courses under development.
- One completed common critical task (for the 2005 common tasks tests) is SCORM v1.2 compliant and 38 common critical tasks under development/update will be SCORM 1.2 compliant.

**Navy**
- All of their WBT content is 1.2 SCORM conformant as long as the LCMS publishes it to SCORM 1.2.
- 80% of the WBT Content is SCORM 1.2

**Air Force**

**Marine Corps**
- 20% of the ADL content is SCORM 1.2 and 80% is AICC
LCMSs and Authoring Tools

**Army**
- Does not specify a specific development tool or LCMS; they require that courseware comply with specific standards regardless of the authoring tool used. Currently they have courseware being developed using Flash, ToolBook, Dreamweaver, HTML editors, and Contractor produced productivity tools. This list is not all inclusive.

**Navy**
- All "A" school content being developed in Outstart Evolution

**Air Force**
- HTML, XML, Flash

**Marine Corps**
- None specified. Some of the USMC's commercial content developers use Outstart Evolution LCMS and some use a proprietary toolset called DOMS
SCORM 2004 Migration

**Army**
- The Army plans to start requiring SCORM 2004 conformance in their courseware development contracts in about 6-9 months (after they receive a SCORM 2004 conformant LMS, develop their business rules, and develop their contract requirements.) Also as existing courses are updated, the plan is to convert them to be SCORM 2004 conformant.

**Navy**
- LMS plans to be SCORM 2004 by Jan 05
- LCMS sometime during early CY05. Navy plans to do some experimentation to determine the efficacy of exploiting certain SCORM 2004 features; in particular sequencing.

**Air Force**
- As soon as LMS vendor is SCORM 2004 - currently planned for Jan 05

**Marine Corps**
- Q1 FY06
Major DoD Acquisition Programs

- Major DoD programs requiring SCORM
  - F-35 Joint Strike Fighter (JSF)
  - Future Combat Systems (FCS)
  - Joint Tactical Radio System (JTRS)
  - V-22 Osprey
SCORM Adoption Outside DoD

- U.S. Government Agencies
  - IRS, CDC, DoL, NGB, NSA, USPS, TSA, VA, NASA, TSWG, others

- Industry
  - Daimler Chrysler, IBM, Microsoft, Boeing, LG, Verizon, Delta Airlines, Oracle, Cisco, McDonalds, Home Depot, others.

- Regions
  - Australia, Canada, Asia, Europe, Latin America
Summary

- Lots of tools ... but still need work on the authoring side
- Conformance and certification programs in place
- Adoption is high
- But what about the future? Stay tuned ...
Topics – Part 4

- Advanced Issues
- Limitation of the model
- Relevant standards initiatives
Advanced Issues – Context

- SCORM was designed to solve specific problems
- SCORM adopted AICC and IEEE work done in the late 1990’s
- SCORM has solved the basic problems well enough to launch an industry
- But there is still the matter of the “A” in ADL – not to mention the “D” and the “L”
Limitations of the Model

- No SCO – to – SCO communication
- “Global” objectives are local to LMS
- Dynamic content is a problem
- Teams not part of the pedagogical model
- Assumes Browser / Dynamic HTML environment
- Security not part of the model
- Model does not address content development / deployment workflow
- Reuse / repurposing depends on more than interoperability (e.g. XML formats)
Example: Cross-domain Issue (Consequence of Browser Framework)

ADL whitepaper with solutions  Proxy Server Solution

Diagram from ADL

Eduworks Corporation  SCORM Tutorial  02-Apr-06

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Consequences ...

- Simulations
  - SCORM systems deal best with summarized data (e.g. completion status)
  - State persistence is an issue for launching simulations from within SCOs
  - Managing multiple learners is an issue

- Experiential Training
  - Competency models are limited
  - Global objectives required
  - Rules-based processing is unsophisticated
Relevant Standards Initiatives

- **Sharable State Persistence (SSP)**
  - IMS specification
  - Allows SCOs to remember state of external object
  - Envisioned for use with simulations
  - Practice?

- **Package Exchange Notification Services (PENS)**
  - Authoring tool / Repository notifies LMS when content is available or has been updated

- **Competency**
  - IMS / (IEEE) Reusable Competency Definitions
  - Ontology mapping (W3C)
More Relevant Standards Initiatives

- Learner Information Package
  - IMS Specification (BSI standard)
  - Applications to learner records
- XML Content Formats
  - Many tools use internal XML representations of learning content
  - ADL Prototype has proposed “ODF+”
- Rights Management / Security
- SCORM – SIM Interoperability
  - Meeting on Wednesday
Summary

- SCORM has been successful
- Working in an ADVANCED and DISTRIBUTED environment with multiple forms of LEARNING requires new ideas
- That’s what we will be exploring (on Wednesday)!