Finding the Sweet Spot

Bridging X3D, S1000D, and SCORM for Embedded Performance Assessment and Life Cycle Training Content Management

The 10th Annual MOVES Research and Education Summit
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### Finding the Sweet Spot: Bridging X3D, S1000D, and SCORM for Embedded Performance Assessment and Life Cycle Training Content Management

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**Prepared by ANSI Std Z39-18**
Sweet Spot Project Objectives

Enable accurate, embedded assessments in virtual environments by

- Integrating X3D, S1000D, SCORM standards
- Capturing performance data using SCORM
- Life-cycle managing assessment content and 3D graphics using S1000D in a Common Source Database
# Foundational Standards

<table>
<thead>
<tr>
<th></th>
<th>X3D</th>
<th>S1000D</th>
<th>SCORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>What it is:</td>
<td>XML-based ISO standard for representing 3D computer graphics</td>
<td>XML-based technical data spec</td>
<td>XML-based collection of standards and specs to package and track e-Learning in an LMS</td>
</tr>
</tbody>
</table>
Conceptual “Sweet Spot”
Significance

• Assessment
  – Enable constructed-response assessment as needed for higher order thinking skills
  – Extend SCORM capabilities beyond verbal learning

• Life Cycle Management
  – Align assessment content with fielded systems and technical data
Demonstration
Learner Task 5.1: Inspect tire for foreign objects, remove if found

Instructions:
1. View tire by selecting viewpoints
2. Fully rotate and closely inspect the tire for damage
3. Then remove any foreign objects by selecting them

When ready:
- Perform this Task Again
- Continue with Assessment

Task feedback:

Assessment events are first reported from X3D to HTML via DOM, then to the Learning Management System (LMS).

HTML X3D script trace:
- Initial Successful([2] Task5_1.js setupListeners() start;)
- [3] Task5_1.js setupListeners() complete;
Task assessment success

Learner Task 5.1: Inspect tire for foreign objects, remove if found

Instructions
1. View tire by selecting viewpoints
2. Fully rotate and closely inspect the tire for damage
3. Then remove any foreign objects by selecting them

X3D Scene

Congratulations, you have removed the nail

Task feedback

Full Wheel Rotation Complete
Nail Removed After Rotation
Elapsed time 22.9 seconds

Assessment events are first reported from X3D to HTML via DOM, then to the Learning Management System (LMS)

HTML-X3D script trace

[4] Task5_1.js.setListeners() complete;
[0] Task5_1.js.start() complete;
[6] Time event received from X3D scene;
[7] Time event received from X3D scene;
Learner Task 5.1: Inspect tire for foreign objects, remove if found

Instructions:
1. View tire by selecting viewpoints
2. Fully rotate and closely inspect the tire for damage
3. Then remove any foreign objects by selecting them

When ready:
- Performance Task Again
- Continue with Assessment

Task feedback:
- Nail Selected Prematurely
- Before Rotation

Assessment events are first reported from X3D to HTML via DOM, then to the Learning Management System (LMS).

HTML X3D script trace:
- Initialize Successful
- Task5.1.js setupListeners() start;
- Task5.1.js setupListeners() complete;
- touchPremature() nullTouchedEvent event received from X3D scene,
- Task5.1.js auxStart() start;
- UserInteractionScript userStartSignal = true;
X3D-S1000D-SCORM Communications

Graph of the Flow of Assessment Events/Performance Measures

SCORM-LMS
- User ID
- Run ID
- Bike Train
- Task 5.1
- Duration

INET

Task 5-1 page.html
- Javascript Event Handler
  - Assessment Setup
  - Assessment Response
  - LmsNetcall
  - taskDuration Response

Interface
- method 1
- method 2
- method n

Task 5-1.x3d
- Elements
- Tire
- -touchSensor
- -Javascript header

S1000D?
- Learn DM

XSLT

ADVANCED DISTRIBUTED LEARNING
Accomplishments to Date
Period of Performance: March – November 2010

- Cognitive Task Analysis for repairing bike tire
- Storyboard system and assessment
- X3D passing progress data to SCORM and LMS
- Commit assessment content to S1000D learning DM
- Build out full sample system and assessment
- Build XSLT to convert S1000D to html
- Write analysis paper
# Sweet Spot Project Team

<table>
<thead>
<tr>
<th>Member</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
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<td>ADL/IDA</td>
<td>Project Lead Writer/Researcher</td>
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<tr>
<td>Leslie Lucas</td>
<td>SLC</td>
<td>Cognitive Task Analyst</td>
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<td>Eric Roberts</td>
<td>ADL/IDA</td>
<td>Assessment Designer</td>
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<td>Schawn Thropp/Tyler Shumaker</td>
<td>ADL/CTC</td>
<td>SCORM Analyst</td>
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<td>X3D Development Team</td>
</tr>
<tr>
<td>Peter Smith</td>
<td>JADL</td>
<td>Immersive Tech. Analyst</td>
</tr>
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X3D - Extensible 3D Graphics Int’l Standard

• Web capable, scene graph and text (XML)-based encoding
• Expresses geometry, behaviors, user interaction
• Affords life-cycle management via archival publications and content reuse
S1000D – Industry Technical Manual Spec

- Serves as authoritative source data stored in a Common Source Database as
  - Metadata defines type for S1000D player output
  - Content divided into XML-formatted Data Modules

- Promotes content reuse by serving as a vendor-neutral format for all technical data

- Enables management of technical training content and notification of engineering change proposals
SCORM – e-Learning Standards & Specs

- XML-based package of
  - Learning resource content to be delivered to the learner at run-time via a learning management system (LMS)
  - Metadata that define the context of packaged content
  - Processing instructions, to tell an LMS what to do with the content
- Enables interoperability of content across SCORM compliant LMSs
- Enables tracking of learner performance
The complete S1000D™ specification, data dictionary and the bike data set can be downloaded from the the s1000d.org web site.
## Design Traceability Matrix

**SweetSpot project:** task maps, learning objectives, observable variables, X3D scenes, events, feedback

<table>
<thead>
<tr>
<th>Question id=&quot;x&quot;</th>
<th>lcValue=&quot;y&quot;</th>
<th>Objective/goal</th>
<th>Observable Variable(s)</th>
<th>X3D Scene: Objects and States</th>
<th>Feedback Condition</th>
<th>X3D eventSensor</th>
<th>FeedBack</th>
</tr>
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<tr>
<td>Task 5.1</td>
<td>Inspect the tire for foreign objects and remove any if found</td>
<td>Inspect tire thoroughly for existing and potential new source(s) of puncture. Discover and dispose of found source(s) properly.</td>
<td>- status</td>
<td>Objects: - bike tire - foreign objects - trash can - clock</td>
<td>Learner does not initiate interaction with the tire after duration but duration &lt; maxDuration</td>
<td>No tire touchSensor activation for seconds</td>
<td>&quot;Hint: Have you inspected for foreign objects that might have caused the puncture(s) or cause future punctures?&quot;</td>
</tr>
<tr>
<td>Task 5.1</td>
<td></td>
<td></td>
<td>- duration</td>
<td></td>
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Life Cycle Management of Equipment-based Virtual Training and Assessment Content