FIRST IN A SERIES

A Technical Development Strategy for Bridging S1000D and SCORM®

Part 1: Planning Project Report

A Report by
The International S1000D-SCORM Bridge Project Team

Sponsored by: The Advanced Distributed Learning Initiative (ADL) and
The ADL Job Performance Technology Center (JPTC),
part of the U.S. Office of the Secretary of Defense, Personnel & Readiness (OSD/P&R)

The Norwegian Defence Logistics Organisation

The Swedish Defence Materiel Administration
(commissioned by Swedish Armed Forces)

S1000D THE BRIDGE PROJECT SCORM

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1 Executive Summary

This report is the deliverable from The International S1000D-SCORM Bridge Project Team. Sponsors for this Technical Development Strategy are The Advanced Distributed Learning Initiative (ADL), ADL Job Performance Technology Center, the Norwegian Defence Logistics Organisation and the Swedish Defence Materiel Administration (commissioned by the Swedish Armed Forces).

The sponsors tasked the team with defining requirements for a specification that integrates learning content authoring environments based on the Shareable Content Object Reference Model (SCORM) with S1000D common source databases (CSDBs). The specification will improve technical learning data readiness during life cycle logistics which support products and systems that require continuous modifications and changes.

Technical learning content not factored into life cycle logistics leads to misalignments of authoritative source content and the products it supports which leads to wasteful spending. There are several reasons for the misalignments:

- Learning and technical content are managed in different formats.
- Learning and technical content are managed in separate locations.
- Learning and technical content are rarely linked.
- Learning and technical content developers do not collaborate.
- Learning content developers are notified of product changes after the product is deployed.

The team met three times from September to December 2008. It defined problems statements, use cases, and functional requirements that would drive the specification development. The team also concluded that future bridge projects must factor integrated logistics support (ILS) into the life cycle management of technical learning content to guarantee fully sustainable data readiness.

The specification will enable a government to

- acquire, manage and produce integrated training and technical information in vendor-neutral formats
- reduce life cycle maintenance costs
- produce data that are system-accurate
- distribute data on schedule.

The S1000D-SCORM Bridge Project will start in February 2009. It will be sponsored by the U.S. Office of the Secretary of Defense, the ADL Job Performance Technology Center, the Norwegian Defense Logistics Organization and the Swedish Defense Material Administration (commissioned by the Swedish Armed Forces)

Strategic Vision

To ensure learning data and technical publication data are developed and maintained based on consistent ILS data.

See Section 4.1

Tactical Problem Statements

Vendor-neutral communication protocols do not exist between content development tools and CSDBs which would facilitate the life cycle support of S1000D technical content for learning.

There are no vendor neutral tools in place to validate SCORM 2004 conformancy at the end of the publishing process.

See Section 4.2

Use Cases

The Team developed a set of workflows requiring communication between learning content authoring environments, SCORM compilers, and CSDBs.

See Section 5.

Functional Requirements

The Team created a set of functional requirements for a specification derived from use cases to facilitate the life cycle support of S1000D technical content for learning.

See Section 6

2 Project Motivation and Objectives

2.1 Project Motivation

The goal to educate and train in rapidly changing technical environments requires information products of many types to be efficiently updated and distributed to the right people at the right time and in the right format. To reach this goal organizational practices that have historically delayed training content production until after products and systems are deployed must share common business processes and infrastructure, such as data acquisition, production, management and delivery. Sharing business practices and infrastructure is now possible with the release of the S1000D Technical Data Specification, Issue 4.0. The release provides a data strategy that allows learning data to be expressed in a neutral way that directly ties content to products, components, and doctrines. S1000D is an ideal part of a data readiness solution because:

- S1000D has been widely adopted across programs and countries.
- S1000D uses XML, the very nature of which is neutral, nonproprietary and portable.
- S1000D supports data interchange between programs and vendors.
- S1000D ties each item of data to a system component via a Standard Numbering System (SNS), a set of unique codes.

Data neutrality supports the development of learning content without dependence on proprietary tools. The data neutrality strategy helps enable data reuse. Without data neutrality, reuse between technical data and training is likely to be copy and paste when it should be based on configuration management information. Cut and paste is antiquated, costly, error prone and introduces schedule lag time.

Lag time could be avoided if there were systematic ways to notify learning content developers which product design changes that affect learning content are made to technical documentation. A tie between neutral formats and product components means that engineering changes can more rapidly flow into learning content products.

Improvements to reuse and change notifications must be achieved according to interoperability principles: a common communication specification must exist between (1) learning content development environments, (2) S1000D CSDB environments and (3) SCORM compile tools. Developing and deploying such a common communication specification is the primary motivation behind the International S1000D-SCORM Bridge Project.

Improved harmonization between S1000D and SCORM is the strategy for achieving the project objective. The creation of a bridge between authoring environments and CSDBs will enable both communities to collaborate and to integrate business processes. The project was conceived to fulfill the following operational objectives:

- Develop a specification for a bridge to integrate any authoring tool to a CSDB.
- Allow for all technical and learning data to be shared across programs, CSDBs, and authoring environments.

2.2 Project Objectives

The planning project goals for the S1000D-SCORM Bridge Team were:

1. Identify a set of problem statements that encompass the issues associated with the misalignment of life cycle logistics and technical learning content.

   The Strategic Vision Statement is listed in Section 4.1 and the Tactical Problem Statements are listed in Section 4.2.

2. Develop a set of use cases and functional requirements for the development and implementation of a specification that will:

   a. connect to and work in any S1000D database from any editor

   b. originate learning content in S1000D data modules, and locate and reuse these modules

   c. compile SCORM content packages from S1000D databases.

   d. identify data modules directly linked to a product design change

   Use Cases are detailed extensively in Section 5.

3. Produce a "technology development strategy" for the development of the S1000D-SCORM Application Programming Interface (API) Bridge to include a description of tasks and deliverables as input for future projects.
   Section 7 contains the recommended tasks and deliverables.

4. Review S1000D Issue 4.0 to identify potential change requests that improve SCORM content support.

   Section 8 details the support gaps and recommended actions.

3 Planning Project

3.1 Project Management

The planning project is an international collaboration and this is reflected in the organizational structure.

Main Project Lead
Wayne Gafford, ADL JPTC

European Project Lead
Sylvia Schwab, Corena

Product Development Managers
Schawn Thropp, CTC Technologies
Harvey Greenberg, XyEnterprise

Project Document Director
Jorunn Newth, Mintra

3.2 Project Team

Working in other consortiums and community user groups, founding members had previously recognized the need for compatibility between SCORM and S1000D. Sponsorship for a specification that would allow for interoperability between the two standards was sought from within the SCORM and S1000D user community and enthusiastically granted. From there, the Bridge Project Team evolved as team members joined based on strategic competencies in areas of:

- the relevant international specifications and standards (S1000D, SCORM, PLCS)
- standards development and management
- content development and management
- database management
- instructional design
- user requirements gathering

3.3 Meetings

The team met three times during the planning project:

- St. Louis, Missouri; September 8-12
- Oslo, Norway; November 3-7
- Arlington, Virginia; December 15-18

Between meetings, project members worked in groups to elaborate on use cases and specification requirements. Two teleconferences were arranged to report on progress.

3.4 Participating Organizations

Representatives from the following organizations were part of the International Bridge Project Planning Team.

ADL Initiative
Dr. Robert Wisher
Peggy Lewis
GA Redding

ADL JPTC
Wayne Gafford

The Boeing Company
Ryan Augsburger
Denny Raitz

Corena
Svante Ericsson
Sylvia Schwab
Tommy Sivertsen

CTC Technologies
Schawn Thropp

Det Norske Veritas (DNV)
Trine Hansen
Leif Tonning

Fraunhofer IDMT
Fanny Klett

Garrison Consulting
Richard Garrison

Giunti Labs
Andrea Gentili
Bryan Eldridge

Institute for Defence Analyses
Jennifer Brooks

Intelligent Decision Systems, Inc.
Stephan Worsham

Isselnord
Francesco Isoppo
Stefano Tedeschi

L-3/DP Associates
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Lockheed Martin
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Mintra
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Johan Bottheim

MTS Technologies
Paul Jesukiewicz
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Norwegian Defence ADL Centre
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Norwegian Defence Research Establishment (FFI)
Joachim Reitan
Rune Stensrud

Norwegian Defence Systems Management Division (NDSD/IM-PLCS)
Tor Arne Irgens

Saab Aerotech
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Mårten Szymanowski
Carl Wilen

SAIC
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Swedish Defence Materiel Administration (FMV)
Anna Öhrnell

US Navy
Dr. Leslie Lucas
Ron Stonecypher
Ken Waringa

XyEnterprise
Harvey Greenberg

3.5 Sponsoring Acknowledgements

The following organizations supported this initiative through their participation and their sponsoring of other participants:

ADL

ADL JPTC

Norwegian Defence Logistics Organisation

Swedish Defence Materiel Administration (commissioned by the Swedish Armed Forces)

4 Strategic Vision and Tactical Problem Statements

At the initial project planning meeting in St. Louis, the team crafted a strategic vision and identified tactical problem statements that impede that vision. The vision and problem statements are foundation for the development of use cases and functional requirements described in sections 5 and 6, the underpinnings to the S1000D-SCORM API Bridge.

The Strategic Vision (Section 4.1) provides a view of technical publications and training products within an ILS context and ensures overall alignment with other disciplines. The Tactical Problem Statements (Section 4.2) provide the practical approach to achieving the strategic vision through the API Bridge.

4.1 Strategic Vision Statement

The project is about ensuring that all source data for technical publications and training products are developed in a common environment, and maintained using consistent ILS standards. ILS involves any activity that supports a product or system, other than actual use of the product and includes all data used for performance support and training purposes.

The practices of logistics include:

- acquisition
- storage
- delivery
- change management
- customer support
- redesign processes
- sustainability
- installation and disposal

Strategic Vision

To ensure learning data and technical publication data are developed and maintained based on consistent ILS data.

As groups producing technical publications and training products operate within an integrated logistics environment, a CSDB must receive input from disparate production systems through a common data exchange, as illustrated in **Figure 1** . To achieve this vision, exchange packages must be defined, and the work must be founded on internationally agreed upon ILS standards, such as those provided by the Product Life Cycle Support (PLCS) standard (ISO 10303-239).

Development of the API Bridge will focus on data exchange between learning content authoring environments and CSDBs during the production of learning information to be used in SCORM-conformant training products. Future projects will then focus on data exchange between CSDBs and Learning Management Systems (LMS).

4.2 Tactical Problem Statements

The API Bridge will offer functional improvements to the development of learning content that must be configured with and based on authoritative source information. **Figure 1** identifies the two main focus areas in red circles. The red circle in the edit column corresponds to tactical problem statement number one. The red circle in the publish column corresponds to tactical problem statement number two.

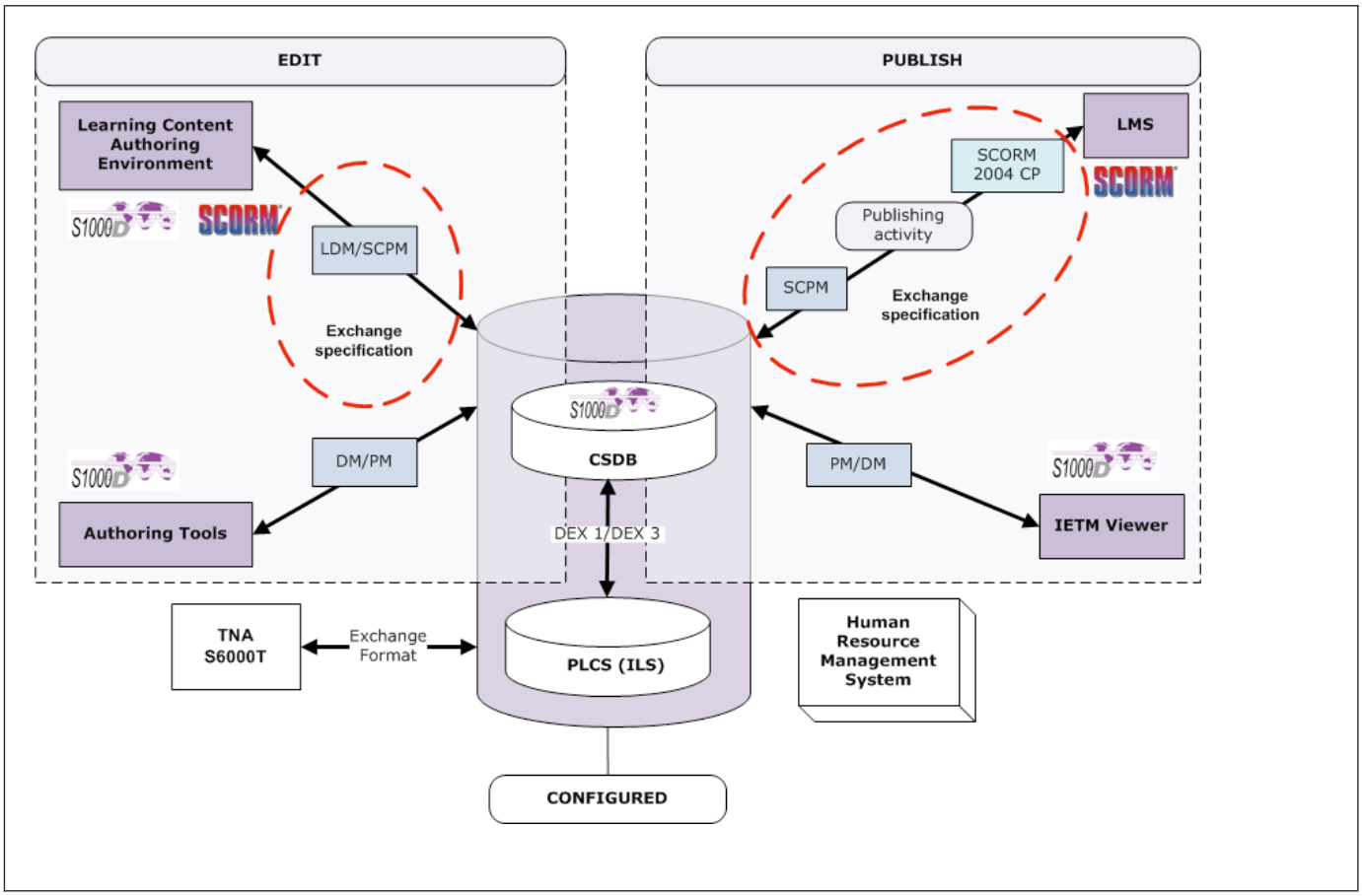


Figure 1. The red circles identify the two main focus areas addressed by the S1000D-SCORM Bridge Project. Tactical Problem Statement 1 identifies the inefficiencies in the Edit Cycle (left in the schematic) and Tactical Problem Statement 2 identifies those in the Publish Cycle (right in the schematic).

Tactical Problem Statements

1. Vendor-neutral communication protocols do not exist between content development tools and CSDBs which would facilitate the life cycle support of S1000D technical content for learning.

2. There are no vendor neutral tools in place to validate SCORM 2004 conformancy at the end of the publishing process.

Although the arrow in the publish column connects the CSDB/PLCS environment to a learning management system (LMS), problem statement number two only focuses on standardizing the extraction of information when creating a SCORM Content Package in a CSDB. The project is not focused on the automatic delivery of a SCORM package from a CSDB to a LMS at this time.

The problem statements focus attention in two content production areas within a larger ILS environment. The project team then took the next step to identify use cases set within the problem spaces that articulate scenarios to be addressed by the S1000D-SCORM API Bridge. Use cases are discussed in the next section.

5 Use Cases

5.1 Introduction

In order to derive functional requirements for the specification, the Team considered various scenarios in which learning content developers in an authoring environment would require interaction with a CSDB in order to create, store and maintain S1000D-compliant learning content that may be packaged in compliance with SCORM. The sequences of likely interactions were described in terms of use cases.

5.2 General Preconditions

It is assumed that a populated CSDB supporting an S1000D project already exists with all required elements.

5.3 General Notes

5.3.1 User Interfaces

It is the Project Team's considered opinion that the design of user interfaces is best left to each vendor, and the use cases and flow charts below reflect this by focusing on the communication points needed between the systems. Even where user interaction is indicated, it is not necessarily obligatory. For example a vendor may chose to implement an automated query.

5.3.2 Communication Considerations

The connection between the systems can be implemented in different ways. For example, it may be implemented as a persistent connection per session or as web services. The use case flows are intended to be neutral on this point.

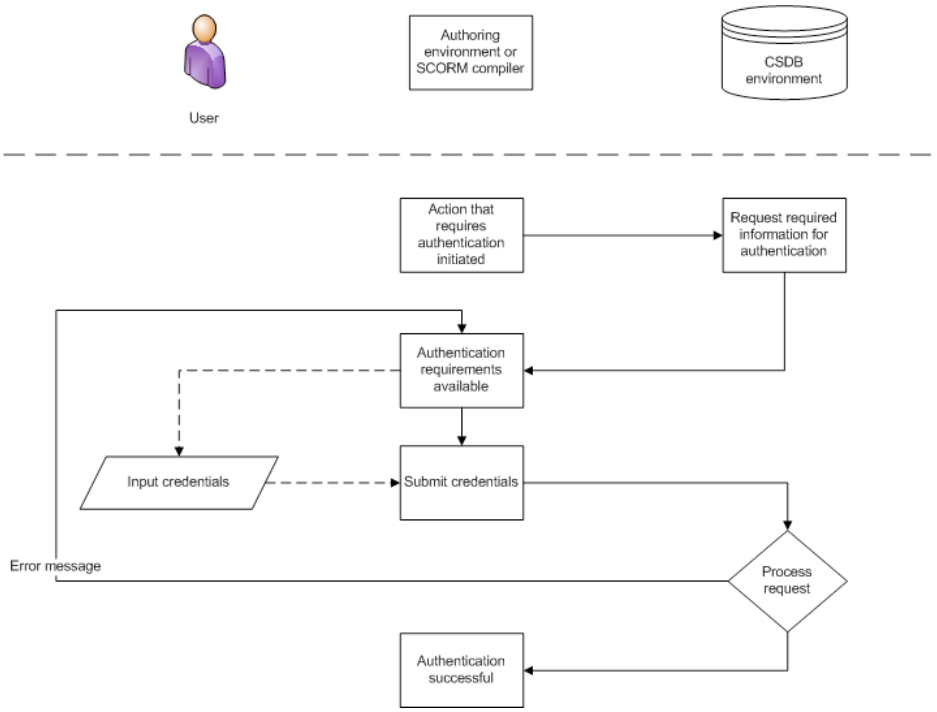
5.3.3 Confirmation Requests

Some actions, especially radical actions such as the deletion of a CSDB object, may require a confirmation from the user that is communicated through the authoring environment. This is likely to be an implementation issue where, for example, some CSDB environments request confirmations for more actions than others. This flow is not made explicit in any of the use cases. The need for an API to support confirmation requests should nonetheless be explored.

5.4 Use Case Descriptions

The Project Team defined and developed eight use cases. Each use case is developed in a common template. Each use case is linked to functional requirements in section 6. Use case names and descriptions begin in section 5.4.1

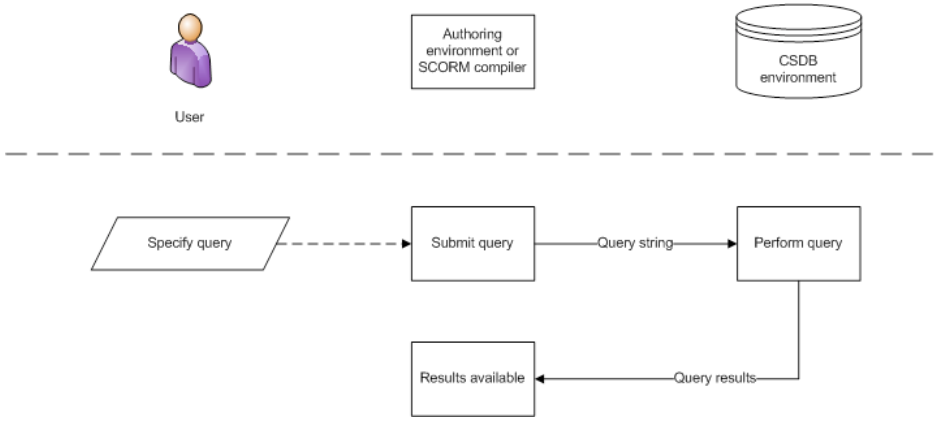
5.4.1 Authenticate With CSDB

Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	Authoring environment gains access to and has permissions handled by CSDB environment
Precondition	Connectivity to CSDB environment is available to the actors
Postcondition	Actors have accessed CSDB environment
Notes	In the case of a web service-based API implementation, every API call may need to include an authentication request. See Section 5.3.3 The required parameters will vary between CSDB environments. It should be a function of the CSDB to determine what is required and prompt the actor(s) for it.
Flow	

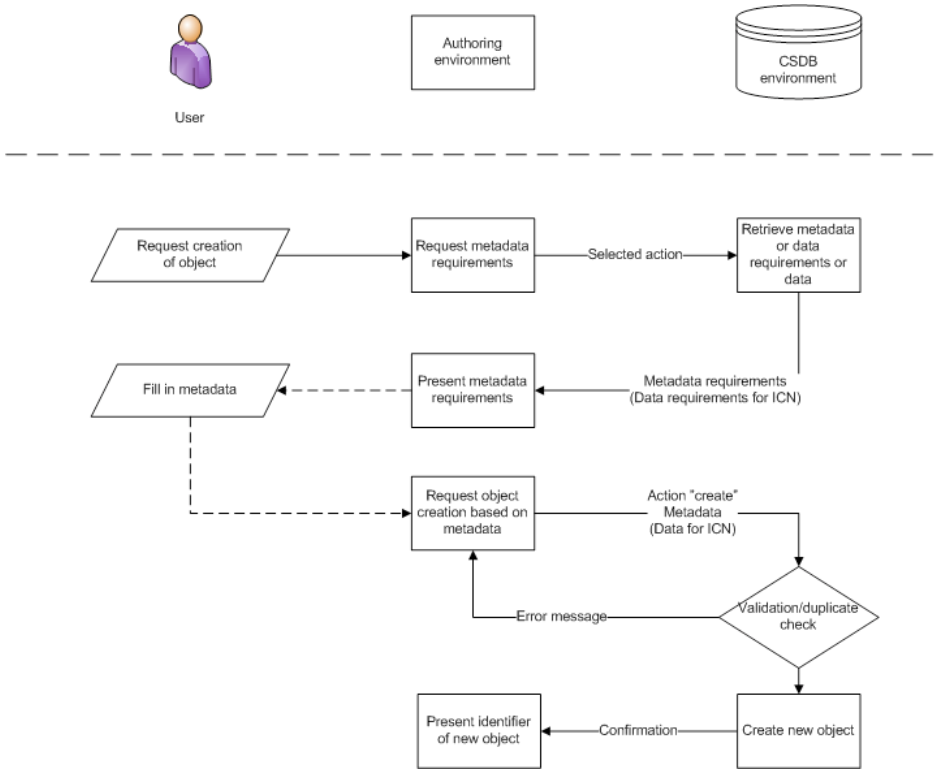
5.4.2 Query CSDB

Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	Actors retrieve the requested data from CSDB environment
Precondition	CSDB access is available and authentication is handled
Postcondition	Actors have access to results as specified by query or appropriate error has been returned

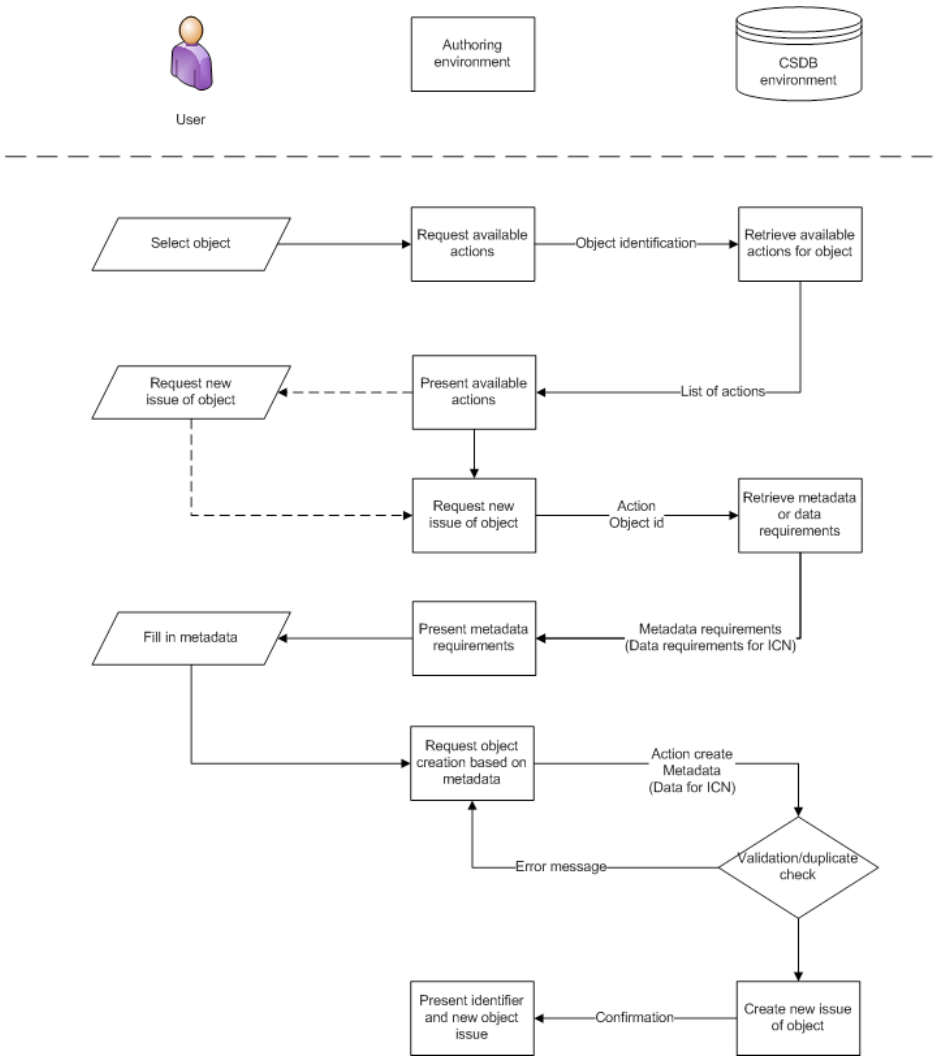
Notes	Typical search scenarios:
	• Search for CSDB objects requiring a review
	• Availability within the CSDB:
	  • Text search
	  • Pre-identified item
	  • Mix of free and specified content
	  • Aggregated content items
	  • Metadata search
	  • Media search
	• Relationships
	  • Data module to data module
	  • Instances a CSDB object is used
	  • Data modules to graphics
	  • Find information on a known CSDB object
	  • Find utilized metadata
	  • Get CSDB object for view
	  • Get available actions for a specific CSDB object
	The search criteria and results will be identified in greater detail in the next project phase.

Flow	

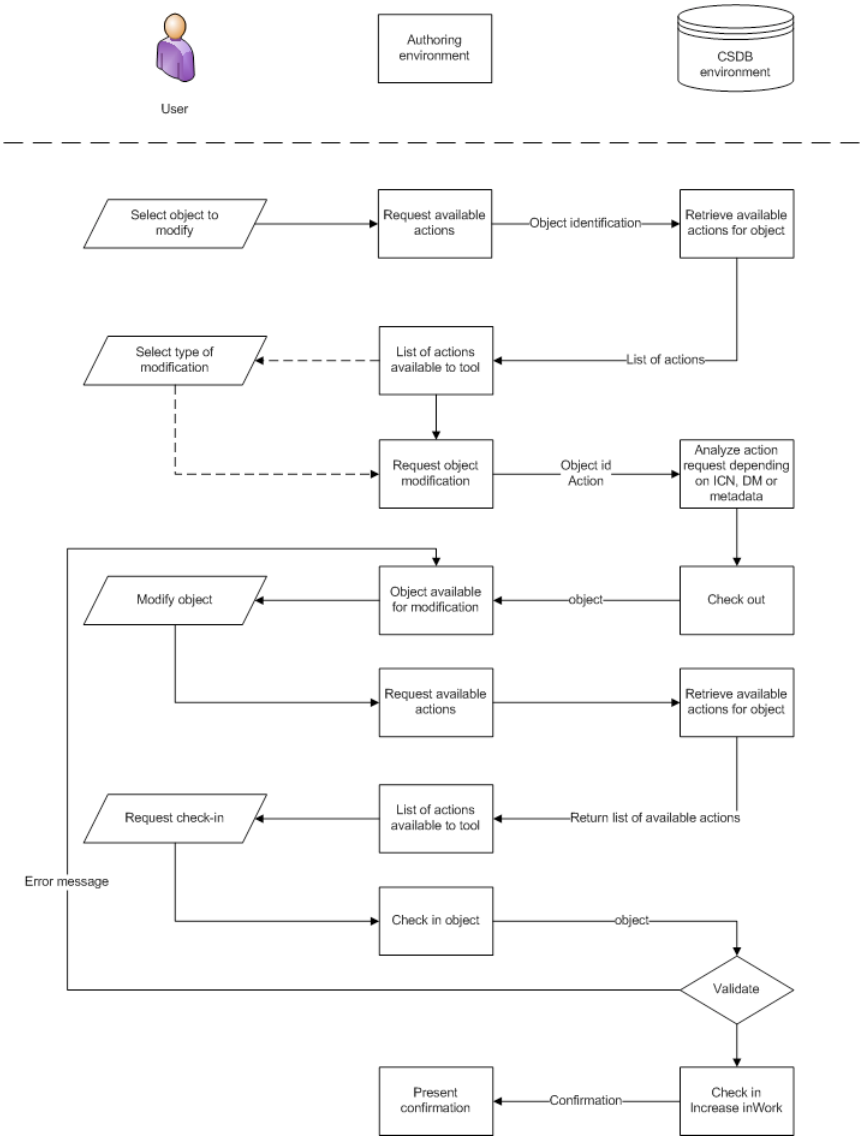
5.4.3 Create CSDB Object

Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	User instantiates a new CSDB object inside the CSDB environment using the authoring environment
Preconditions	1. CSDB connectivity is available and authentication is handled. 2. The object identification structure has been established for the CSDB object
Postcondition	A new CSDB object has been created and stored in the CSDB environment and is available for modification
Flow	

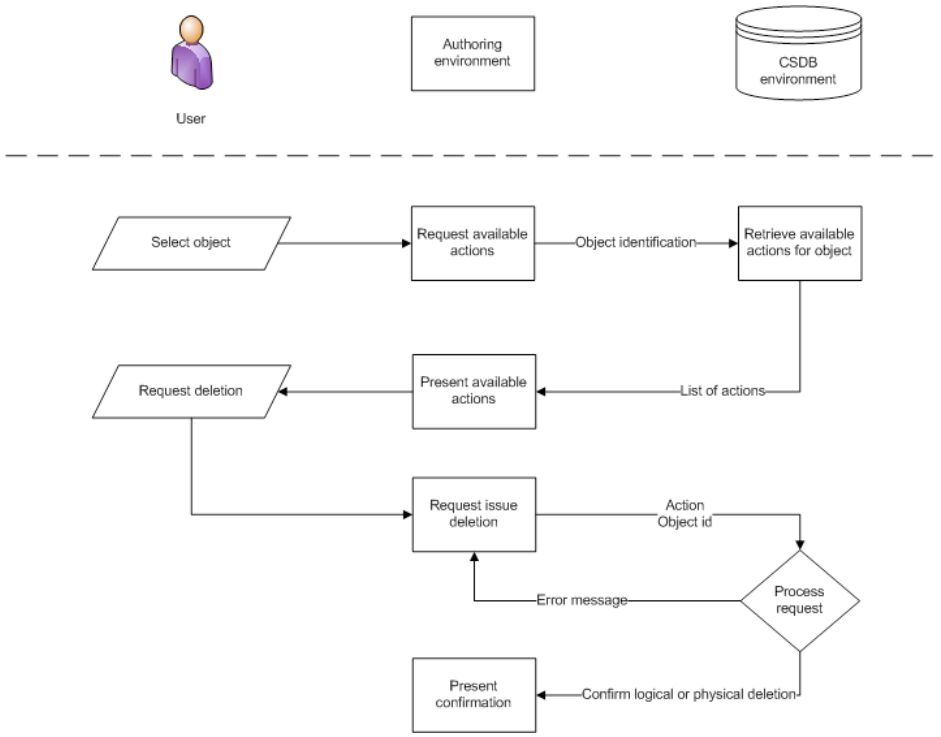
5.4.4 Create New Issue of CSDB Object

Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	User creates a new issue of an existing issued object inside the CSDB from the authoring environment for the purpose of starting modifications for the next issue cycle of the object.
Preconditions	1. CSDB connectivity is available and authentication is handled 2. The object identification structure has been established for the CSDB object
Postcondition	A new issue of the CSDB object has been created and stored in the CSDB environment
Flow	

5.4.5 Modify CSDB Object

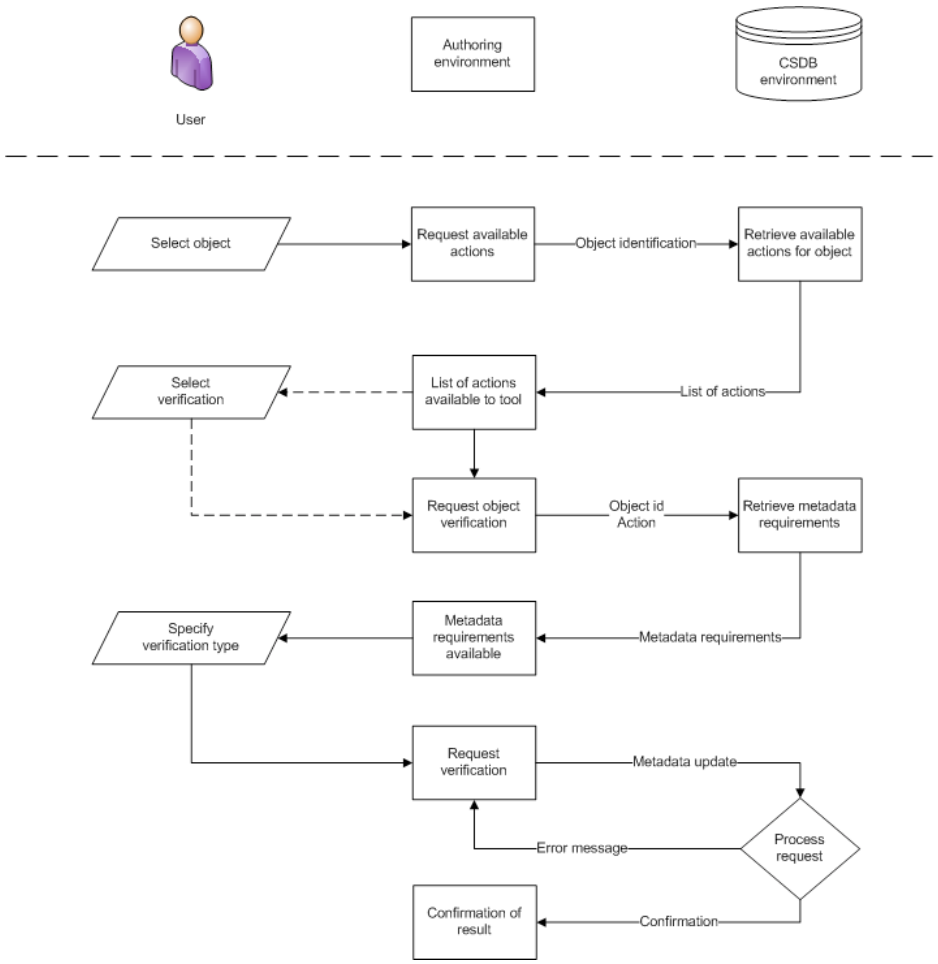
Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	User modifies a CSDB object (including its metadata) inside the CSDB using the authoring environment
Preconditions	1. CSDB connectivity is available and authentication is handled 2. User has identified a CSDB object that will be subject to modification
Postcondition	The modified CSDB object is stored in the CSDB environment
Flow	

5.4.6 Delete CSDB Object

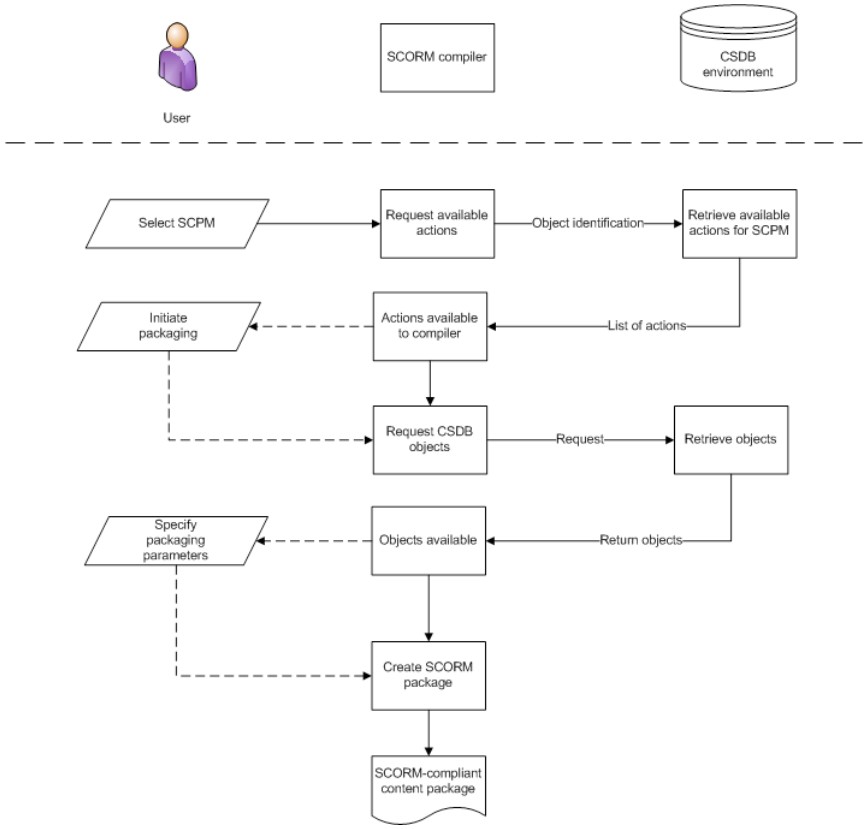
Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	User physically or non-physically deletes* CSDB object from CSDB using the authoring environment
Preconditions	1. CSDB connectivity is available and authentication is handled 2. User has identified an object for deletion
Postcondition	Object is physically or non-physically deleted from CSDB
Notes	S1000D does not allow the actual deletion of any CSDB object that has beenissued. Such objects will be given the status “Deleted”, referred to as “non-physical deletion” above.
Flow	

*Non-physically removed objects may be reinstantiated through the flow described in Section 5.4.4

5.4.7 Modify Quality Assurance (QA) Status of CSDB Object

Actors	Users of authoring environment or SCORM compiler Authoring environment or SCORM compiler CSDB environment
Goal	User modifies QA status of CSDB object in CSDB using the authoring environment
Preconditions	1. CSDB connectivity is available and authentication is handled. 2. Project-specific processes have ensured that CSDB objects of concern are verified
Postcondition	The quality assurance metadata of the CSDB objects reflect the results of the quality assurance process
Flow	

5.4.8 Package for SCORM

Actors	Users of SCORM compiler SCORM compiler CSDB environment
Goal	SCORM compiler creates a SCORM-compliant content package based on resources contained in CSDB
Preconditions	1. CSDB connectivity is available and authentication is handled 2. An S1000DSCORM content package module (SCPM) is available and identified 3. All the required content objects are available in CSDB environment 4. SCORM-compliant content package sequencing and navigation is supported by information in the CSDB environment 5. SCORM-compliant content package communication scripting is supported through the CSDB environment
Postcondition	CSDB objects have been compiled and packaged as a SCORM-compliant content package ready to run on a SCORM-compliant LMS
Notes	The process requires the transformation of an SCPM into an IMS manifest file. Future projects will explore an S1000D "profile" of SCORM, where a LMS would read the S1000D SCPM directly. Over time, the API should be able to accommodate several live connections, including • only the IMS manifest file is created by the SCORM compiler and the LMS accesses objects dynamically, • creating SCORM packages including all referenced files for import to LMS. The requirements for supporting the former approach will be explored in greater detail as this project progresses.
Flow	

6 Functional Requirements Mapped to Use Cases

A functional requirement is defined as "a requirement that specifies a function that a system or system component must be able to perform." (IEEE Standard Glossary of Software Engineering Terminology).

The following functional requirements were derived from the uses cases described in Section 5. These requirements will be the basis for the S1000D-SCORM Bridge Specification.

No.	Requirement	Appplicable Use Cases
1	The specification shall support the ability to retrieve a list of metadata requirements for a specific action.	Create CSDB Object Authenticate with CSDB Modify CSDB Object Create New Issue of CSDB Object Modify QA Status of CSDB Object
2	The specification shall provide a means to identify the required metadata needed for authentication in a CSDB environment.	Authenticate with CSDB
3	The specification shall provide a means to submit the required metadata needed for authentication within a CSDB environment.	Authenticate with CSDB
4	The specification shall support the ability to retrieve a list of supported query types (e.g., text, media, metadata).	Query CSDB
5	The specification shall support the ability to submit a query to a CSDB environment.	Query CSDB
6	The specification shall support the ability to obtain query results from a submitted query.	Query CSDB
7	The specification shall support the ability to retrieve a list of allowable actions based on a given project and user roles.	Create CSDB Object Query CSDB
8	The specification shall support the ability to retrieve a list of object types that can be created within the CSDB environment.	Create CSDB Object
9	The specification shall support the ability to provide the object type to the CSDB environment during the creation process.	Create CSDB Object
10	The specification shall support the ability to retrieve a list of allowable values per metadata field.	Create CSDB Object Create New Issue of CSDB Object Modify QA Status of CSDB Object
11	The specification shall support the ability to provide metadata values for each field.	Create CSDB Object Create New Issue of CSDB Object Modify QA Status of CSDB Object
12	The specification shall support the ability to request creation of a CSDB object.	Create CSDB Object

No.	Requirement	Appplicable Use Cases
13	The specification shall support the ability to obtain the status of a requested action.	Create CSDB Object Modify CSDB Object Delete CSDB Object Create New Issue of CSDB Object Modify QA Status of CSDB Object Package for SCORM
14	The specification shall support the ability to identify a CSDB object to perform an action on.	Modify CSDB Object Create New Issue of CSDB Object Modify QA Status of CSDB Object Delete CSDB Object
15	The specification shall provide a means to create a new issue of an existing issued CSDB object inside the CSDB environment for the purpose of starting modifications for the next issue cycle of the CSDB object.	Create New Issue of CSDB Object
16	The specification shall support the ability to retrieve a list of allowable actions based on a given CSDB object and user roles.	Modify CSDB Object Delete CSDB Object
17	The specification shall support the ability to request check out of a CSDB object.	Modify CSDB Object
18	The specification shall support the ability to retrieve a CSDB object. Note: Certain actions may or may not be recognized after retrieval of the CSDB object based on project or CSDB environment policies For example, modifying a CSDB object may not be permitted without a check out.	Modify CSDB Object Modify QA Status of CSDB Object Package for SCORM
19	The specification shall support the ability to request check in of a CSDB object.	Modify CSDB Object
20	The specification shall support the ability to request the deletion of a CSDB object from a CSDB environment.	Delete CSDB Object
21	The specification shall provide a means to set a metadata element without requiring the requesting application to check out, modify and check in (Modify CSDB Object Use Case) the CSDB object.	Modify QA Status of CSDB Object
22	The specification shall support the compilation of a SCORM Content Package Module (SCPM) into a SCORM content package.	Package for SCORM
23	The specification shall provide a means to store a log of the creation and distribution of a SCORM compile operation within the CSDB environment.	Package for SCORM
24	The specification shall provide a means to define SCORM packaging parameters for use during the SCORM compile process.	Package for SCORM

7 Recommended S1000D-SCORM API Bridge Tasks and Deliverables

The SCORM-S1000D API Bridge must meet the functional requirements listed in Section 6 and be vetted against the use cases in Section 5. To ensure technical success and community adoption of the API Bridge, the high level deliverables for the next project should be:

1. A community-reviewed and agreed upon specification for the API Bridge
2. Beta implementations of the API Bridge
3. Best practice guides for implementing the API Bridge (developed from the beta sites)
4. Facilities for the community to give continuous feedback about the API Bridge and methodology to implement it

Another aspect of the overall strategy is the ability to create SCORM content packages from content in a CSDB. Because of community differences, there will not be a single solution for creating a SCORM content package and a specification would not be the appropriate deliverable. Therefore, a guide should be developed that provides (1) specific requirements where appropriate for how to interpret certain S1000D elements in a SCORM content package and (2) best practices where appropriate for creating SCORM content packages when multiple solutions may exist.

7.1 Tasks

In order to create these deliverables, the following high-level tasks are recommended:

1. Define the functionality of the API Bridge.
2. Define the authentication and authorization requirements and solutions for the API Bridge.
3. Create a guide for the creation of SCORM content packages from S1000D content.

These tasks may be pursued in parallel and are described in more detail below.

7.1.1 Define API Bridge Functionality

The API Bridge Functionality is the main work of the API Bridge. This defines the types of information needed to go between the different systems and the actions needed to be accomplished inside the systems. Defining the API Bridge Functionality requires two steps:

1. Verification of the appropriate coverage
2. Creation of the formal specification

The training and technical documentation communities each have their own internal assumptions about work flow, data usage, and data requirements. The two communities collaborated on this Technical Development Strategy and the requirements will be further vetted in the next stage of the project.

The Team recommends that a notional functional API be developed and tested with human actors representing the different types of systems (learning authoring environment, learning delivery environment, and CSDB). The human actors would communicate with each other to "implement" each of the use cases using only commands and data available in the notional API. As gaps are identified, a new notional functional API should be iteratively developed and tested until no more gaps exist and a complete notional functional API can be delivered.

In order to create the formal specification, it must be determined whether multiple bindings of the API Bridge will be needed by the community. Existing specifications should be analyzed to determine if an existing specification closely approximates the requirements of the functional API. If no satisfactory specification exists, a spiral development cycle should be developed with the following steps:

1. Write a specification for a set of functions
2. Create a sample implementation
3. Release the specification and sample implementation to the community for comments and feedback
4. Revise and expand the specification and implementation;

5. Iteratively revise and release the specification until the entire API Bridge has been developed with community approval.

This task would result in a fully documented API and sample implementation that have the support of the community.

7.1.2 Define API Bridge Authentication Requirements and Solutions

Each community defines how users of its systems are authenticated (identified) and authorized (given permissions). The authentication and authorization specification can be created independently of the functional API.

It is likely that the API Bridge must support multiple authentication and authorization systems across the communities that implement it. It should be determined exactly how each community implements authentication and authorization.

There are many existing authentication and authorization specifications. This Project Team highly recommends using one (or more) of the existing specifications and profiling it to meet the requirements of the communities.

This task would result in a fully documented profile of one or more authentication and authorization specifications. This profile should detail how to incorporate authentication and authorization into the Functional API Bridge.

7.1.3 Create a Guide for the Creation of SCORM Content Packages

There are many ways to create a SCORM content package; reasonable people can disagree on the best way to structure a SCORM content package. Likewise, there will be many ways to structure a SCORM content package from content in a CSDB.

On the other hand, some parts of a Learning Data Module must be translated into SCORM API calls in a consistent manner.

Therefore, a guide should be written for how to create SCORM content packages from content in a CSDB. The guide should contain, where appropriate: (1) explicit requirements for how to handle certain S1000D elements, (2) best practices for how to handle the rest of the S1000D elements to create SCORM content packages, and (3) sample S1000D content and resulting SCORM content packages.

The task should result in a guide for creating SCORM content packages from S1000D content as well as sample S1000D content and SCORM content packages.

7.2 Timeline

Each of the three tasks will take approximately one calendar year to complete; each task can be run in parallel with the other tasks.

For the Functional API Bridge task, verifying the appropriate coverage should take about four months, followed by eight months to create the formal specification.

For the Authentication and Authorization task, determining the community requirements should take about four months, followed by eight months to profile one or more existing specifications and integrating them with the Functional API Bridge.

Creating the guide for the creation of SCORM content packages should take about 12 months.

8 S1000D Learning Content Support Gaps

8.1 General

In the process of defining the problem statements, the use cases, the functional requirements and the recommended specification development tasks, several potential gaps in S1000D for support of learning needs have been identified. These potential gaps will be further analyzed and if deemed valid, S1000D Change Proposal Forms (CPFs) will be written and submitted against a future version of the S1000D specification.

Listed below are the potential gaps that have been identified as well as the plan for addressing each gap issue.

8.2 S1000D Change Proposals

8.2.1 S1000D SCORM Content Package Module (SCPM) Split

Description: The S1000D SCPM currently includes references to individual files that will be compiled into a Sharable Content Objects (SCOs). It does not allow for sharing of SCOs. If the same SCO is used in multiple places, then the SCO must be defined multiple times. Reuse could be facilitated by breaking the SCO definition out of the SCPM into its own object.

Actions: Draft white paper with requirements for review as prerequisite for CPF. Review XML elements and attributes

8.2.2 Evaluate the Usage of XPath

Description: XPath is currently available in the SCPM for referencing fragments of other objects. Evaluate the usage and placement of the Xpath element in the SCPM with regards to the complexity of use and possible introduction of referencing errors. Alternate methods of fragment referencing are to be analyzed.

A related issue is the lack of fragment referencing from within a Learning Data Module (LDM). Consideration should be given to the addition of fragment referencing to the LDM.

Action: Draft white paper with requirements for review as prerequisite for CPF.

8.2.3 Support of Run-Time Environment (RTE) Related Files in an LDM/CSDB

Description: It is unknown whether S1000D supports all the file formats needed by learning content developers/systems. Support is needed for both storage of objects within the CSDB environment and references to any type of learning object from an S1000D DM, PM or SCPM.

Actions: Determine gaps and requirements for S1000D storage and referencing support for learning file formats in a CSDB environment. Document results in a white paper as a prerequisite for a CPF.

8.2.4 Interactions Outside the Assessment Branch

Description: Currently the assessment branch within the LDM contains assessment-based interactions with the user (e.g., single choice, multiple choice, matching). However, these interactions should be available in any context for review and instructional purposes.

Actions: Analyze the requirements to make the interactions available in other branches of the LDM. Draft white paper with requirements for new CPF.

8.2.5 Additional Interaction Types in the Assessment Branch

Description: The S1000D assessment schema started with a limited number of question interaction types. Interactions ought to support fill-in and other types,

Action: Perform a comprehensive review of other specifications for interactions that are not supported in the S1000D LDM for new CPF.

8.2.6 Transcript Support on Multimedia

Description: A multimedia transcript is a textual representation of a multimedia object which could take on many forms. S1000D does not currently support a method to capture multimedia transcript content. Provide support for transcripts in S1000D.

Action: Draft white paper with requirements for new CPF.

8.2.7 LDM Improvements

Description: The LDM contains XML structures that describe types of learning content, such as lesson plans, overview, main, summary and assessment data. However, traditional instructional design components are not fully represented that provide a fuller link to product task analyses and job performance requirements.

Actions: Analyze the LDM structure to identify improvements which are more aligned with accepted instructional design principles that link to task analysis and job performance requirements. Draft white paper with requirements for new CPF.

8.2.8 Support for SCORM Sequencing

Description: Sequencing is an essential part of learning and there is currently no identified method to support sequencing in S1000D. Analyze current S1000D capabilities and other possibilities in support for SCORM sequencing.

Actions and deadline for addressing this support will be developed as this project progresses.

9 The Way Ahead: Looking Beyond the API Bridge

New learning content support in the S1000D Issue 4.0 enables the proposed communication specification to integrate SCORM-based learning content authoring environments with S1000D CSDB environments. The specification also supports the compilation of SCORM content packages in S1000D CSDB environments utilizing vendor-independent mechanisms. Improved links between engineering and training are now possible.

PLCS is an international standard used in ILS to validate links between engineering changes, maintenance activities, and technical documentation. By applying PLCS principles, this project creates an opportunity to subject technical learning content to rigorous ILS configuration processes. PLCS might now be extended to support Training Needs Analysis (TNA).

PLCS has demonstrated its ability to hold and manage product support data through the life of a product. With the emergence of an API between SCORM and S1000D applications, the opportunity arises to improve links between task analysis, learning objectives and human performance skills in an ever-changing product support environment. Interoperability and cost of ownership reduction may now be enhanced by a controlled and automated provision of valid and accurate data.

10 References

International specification for technical publications utilizing a common source database, S1000D Issue 4.0 http://www.s1000d.org/?sector=issues&page=download&issue=v4-0

SCORM 2004, 3rd Edition http://www.adlnet.gov/downloads/DownloadPage.aspx?ID=237

11 Terms and Definitions

Acronym	Term	Definition
API	Application Programming Interface	A set of functions, procedures, methods, classes or protocols that an operating system, library or service provides to support requests made by computer programs.
	Asset	Electronic representations of media, such as text, images, sound, web pages or other pieces of data that can be delivered using web technologies.
CSDB	Common source database	An information store and management tool for all objects required to produce technical information products within projects. While this may take the form of a computer database, no particular form or implementation is specified.
	CSDB environment	A physical implementation of a CSDB that can support functions such as data storage and queries.
	CSDB object	Anything stored in a CSDB. This may include data modules, multimedia files, and other file types allowed by the S1000D specification.
DM	Data module	The smallest self-contained information unit within a S1000D-based information product.
DMC	Data module code	A unique identifier for a data module, which includes the product, parts of a product, information type, location and, for learning data modules, the type of learning content.
	Delete	An operation applied to a CSDB object that may be a physical deletion (remove object from the CSDB) or a change in the markup that indicates that this object is no longer required.
	Idstatus	The first part of a data module, containing identification elements (DMC, title, issue number, date, etc) and status elements (applicability, technical standard, QA status, etc) for the management of a data module.
ICN	Information Control Number	A number (set of characters) which gives the address of an illustration sheet or a multimedia object in the CSDB store.
	Instructional design	The practice of creating instructional tools and content to help facilitate learning most effectively.
ILS	Integrated Logistics Support	Processes to ensure support during the entire life cycle of equipment.
	Learning content authoring environment	Authoring tool for learning content with associated components.
LDM	Learning data module	A type of S1000D data module used to support technical training information development.

Acronym	Term	Definition
LMS	Learning management system	Software that automates training event administration through a set of services that launches learning content, keeps track of learner progress, sequences learning objects, and reports student mastery.
	Product	Any platform, system or equipment (air, sea, land vehicle, equipment or facility, civil or military).
PLCS	Product Life Cycle Support	The ISO 10303-239 standard for modelling and managing product and support information.
	Project	The task to develop, maintain and dispose of the Product.
QA	Quality assurance	The collection of checking activities that are carried out to ensure that the contents are fit for purpose and technically accurate.
RTE	Run time environment	A model that provides for common processing across learning management systems after an object is launched.
	SCORM compiler	A process or application that transforms content objects into a SCORM-compliant content package.
SCPM	SCORM Content Package Module	A S1000D XML object that allows coursweware developers to collect training and maintenance modules into a learning product output.
	SCORM-compliant content package	A bundle of content objects or aggregations of content objects together with a content organization in a SCORM-compliant manner.
SCO	Sharable content object	The lowest level of granularity of learning resources that can communicate with an LMS using the SCORM RTE.