SCORM® 2.0 White Paper

Performance*SCORM*:

Supporting Learning Content With
Data Readiness and Life Cycle Logistics

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Abstract

Accurate information is an enduring readiness factor in the execution of missions and human performance. Learning content is one element in an eco-system of documentation, competencies, objectives and business processes that support the use and maintenance of complicated products, systems and machinery. SCORM 2004 does not support data readiness and human performance as well as it could. It does not reference data specifications designed to align information to the products and systems it documents. Current business processes too often allow learning content to become outdated which erodes data readiness and human performance. This white paper recommends that SCORM 2.0 support data readiness, life cycle logistics and human performance by directly referencing and utilizing S1000D and the Darwin Information Typing Architecture (DITA) data specification functions.

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1.0 Background

1.1. The invention of the Sharable Content Object Reference Model (SCORM) integrated several learning, education and training-based specifications into one reference model. It improved the distribution of learning content, improved how learning content interoperated with learning management systems, and improved the management and tracking of learners in a self-paced environment. SCORM 2004 is silent on content, format, instructional design, and does not address how learning content is managed and produced in a particular community of practice. The mechanics of SCORM 2004 are largely "neutral" in that it treats all learning content the same within its referencing, reuse, interoperability and sequencing mechanisms.

1.2. SCORM 2004's neutrality is also a weakness in some cases. Not all learning content is treated the same across communities of practices (CoPs). In many CoPs, data are dependent upon authoritative source material, are managed concurrently in a family of documentation, or must be accessed for business process decisions to be made. In the *Life Cycle CoP*, readiness will be improved by aligning learning content with product and maintenance design requirements, authoritative source information and logistical support. This use case is generic and can support data readiness and human performance for any product in a life cycle CoP.

2.0 SCORM 2.0 Requirements

2.1. This paper focuses on the treatment of technical learning content in the larger context of life cycle "eco-system". "Eco-system" is used to represent the stages, elements and business processes that map learning content design requirements that change over time to all the learning elements directly affected by changes to those requirements.

2.1.1. **There are three primary SCORM 2.0 requirements to support life cycle CoP needs:**

1. **Improve SCORM 2004 support for modern content management practices:**
   a. Identify and obtain current learning information from a common source database (CSDB)
   b. Apply configuration management to learning content to obtain the right information in support of a product version.
   c. Integrate CSDB with an available LMS for content update notification to learners and instructors.
   d. Obtain any set of sequenced content outside an LMS. Size of data does not matter.

2. **Diversify SCORM 2004 to allow a CoP to develop and reference its own aggregation model**
   a. A CoP aggregation model will structure resources and organizations. Those structures and metadata will be expressed according to CoP specifications and requirements.
   b. Product life cycle aggregation models will use S1000D or DITA, depending on life cycle requirements.

3. **Integrate SCORM 2004-based learning content development editors with common source databases.**
   a. Learning content developers would have direct access to authoritative source content for reuse.
   b. Learning content developers can leverage S1000D and DITA processing tools.
   c. Common source databases would have direct access to SCORM 2004 compilers to output content packages.

3.0 Life Cycle CoP Problem Statement

3.1. This white paper is based on a single problem statement that will drive requirements in the development of SCORM 2.0.

- SCORM 2004 does not align product and policy requirements to learning elements in the learning life cycle "eco system". SCORM 2004 allows a misalignment of product requirements and learning content. SCORM 2004 does not address the following generic business process question:

  – *What learning elements are affected by a new requirement as dictated by changes to authoritative source materials, including product designs, policies, procedures, legislation and guidelines. Learning elements include:*

    - Learners
    - Instructors
    - School Houses
    - Competencies
    - Objectives
    - Content packages
    - Assets (and reused content)
    - Customers
    - Technical data

4.0 Life Cycle CoP Problem Statement Contributors

4.1. As a reference model, SCORM 2004 does not put requirements on content and format. Its intention is to treat all content equally. This attribute is a factor in supporting interoperability but is a liability in the support of data readiness, life cycle logistics and human performance. SCORM 2004 leaves out or is weak in the use of following metadata types that contribute to the alignment of a life cycle eco-system:

- Configuration
- Applicability
- Competency
- Position description
- Learner profile
- File naming
- Authoritative source

4.2. In the list above, SCORM 2004 may best support a relationship between learning content and an "authoritative source" through the element <relation>. <relation> contains two wrappers: <kind> and <resource>. They describe the relationship between two or more pieces of information and the target component the relationship references. The <kind> element declares an explicit relationship vocabulary. The <resource> element declares the target component as a string.

5.0 SCORM 2.0 Uses Case Discussion

5.1. Technical learning elements must be developed, managed and distributed in parallel with other supporting documentation to support data readiness. In addition, learners must be notified of new and updated courses that affect their performance.

5.2. Requirement(s) associated with product design, procedures, policy and guideline source information must be linked through metadata and data specification functionalities. **Table 1** associates learning elements affected by life cycle requirements with life cycle metadata:

Elements Affected by Life Cycle Requirements	Life Cycle MetaData
Learners	Learner Profile ID
Competencies	Competency ID / Position Description
Content Packages	Configuration
Assets (and reused content)	File naming
School houses	Applicability
Customers	Configuration
Authoritative Source Data	File naming

Table 1: Alignment of Life Cycle Elements to Life Cycle MetaData

5.3. **Life Cycle CoP Use Case Requirement Statement:** a learning content manager must ascertain how a new requirement affects all learning content elements in the life cycle eco-system. **Figure 1** is an example of how a requirement might cascade through a learning life cycle eco-system framework.
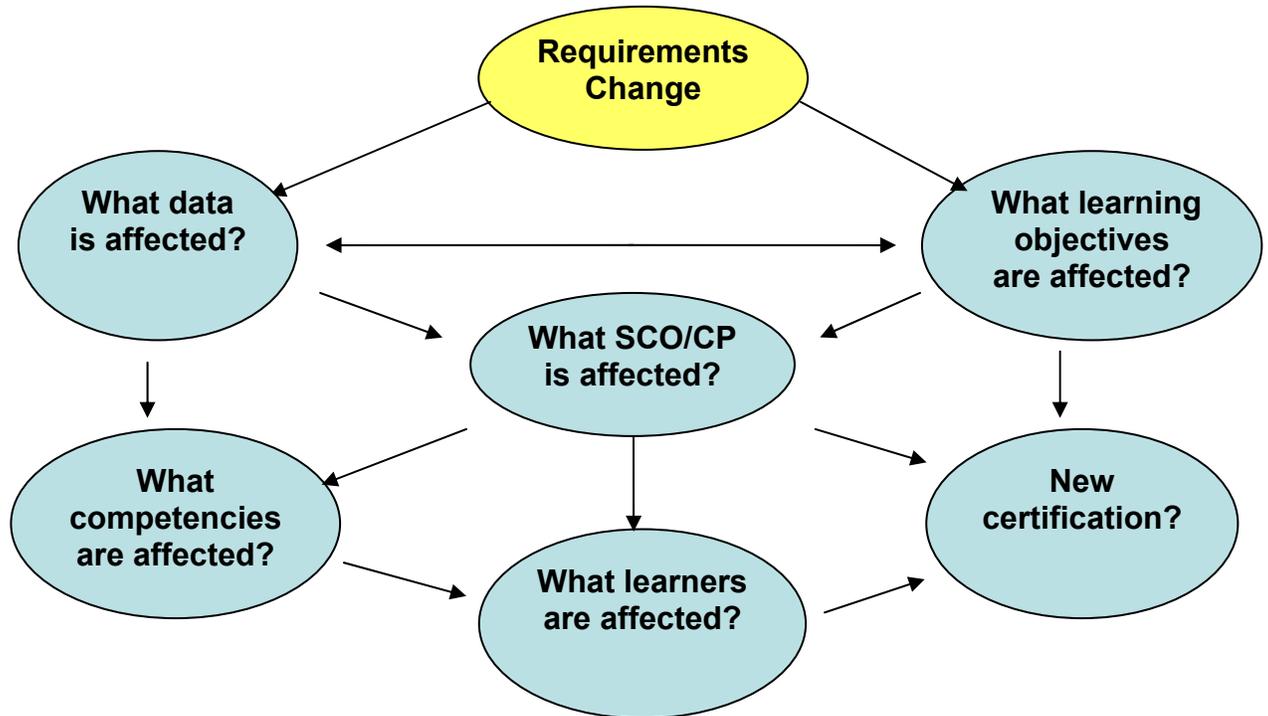

Figure 1: A Sample Learning Lifecycle Eco-System

6.0 Linking SCORM 2.0 Requirements to Solutions that Support the Life Cycle CoP Use Case

6.1. Within the life cycle CoP, alignment of aggregated learning content to learning elements in a life cycle eco-system requires the following data readiness support solutions:

1. Reference the S1000D and the DITA data specifications into SCORM 2.0.
2. Substitute generic SCORM 2004 functions with like S1000D and DITA functions suitable for a CoP to use SCORM 2.0.
3. Develop and reference a new API that enables learning content development tools to have access to any S1000D and DITA common source databases (CSDBs). API will also enable CSDBs to compile S1000D and DITA content into SCORM 2.0 content packages.

6.2. How SCORM 2.0 Development Solutions Will Meet Requirements and Support the Life Cycle CoP Use Case

6.2.1. Requirement #1: Improve SCORM 2004 support for modern content management practices

Solution to SCORM 2.0 Requirement #1: *Reference the S1000D and the DITA data specifications into SCORM 2004.*

S1000D and DITA are data specifications that structure content inside an XML file. Both specifications support chunking content for reuse. S1000D information units are called "data modules". DITA information units are called "topics". They share a common learning content model that supports learning plan development, overview, core learning, summary, and assessment information.

Figure 2 illustrates the S1000D and DITA learning content framework model:

Generated by XMLSpy   www.altova.com
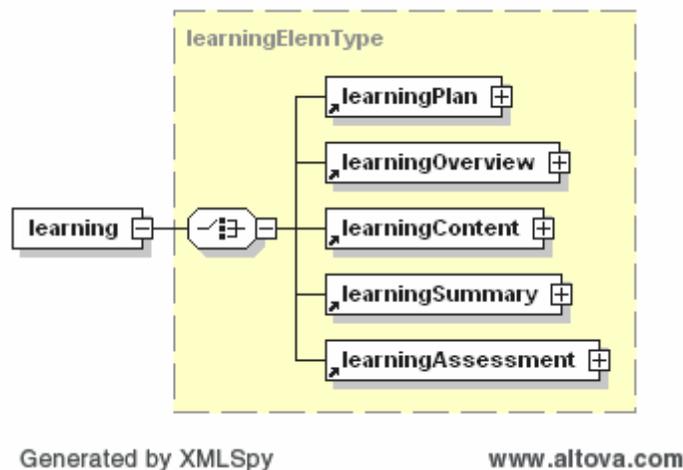
Figure 2: S1000D and DITA Learning Content Framework Model

6.2.1.1. How S1000D and DITA will support data readiness, life cycle logistics and human performance in SCORM 2.0:

1. S1000D supplies life cycle and file naming metadata for content packages, SCOs and assets.
2. S1000D configures learning content directly to products, components and doctrines being taught.
3. S1000D and DITA learning content is explicitly structured in XML
4. S1000D and DITA separate the management of data from presentation formats and applications.
5. S1000D and DITA operate as common digital data formats to support complete family of information products

6. Information marketplace supports S1000D and DITA management and processing
7. S1000D and DITA are CoP-based.
8. S1000D and DITA supports direct access to "chunked" information aligned to performance and learning needs.

6.2.2. Requirement #2: Diversify SCORM 2004 to allow a CoP to develop and reference its own SCORM 2.0 functions, such as a content aggregation model

Solution to SCORM 2.0 Requirement #2: *Substitute generic SCORM 2004 functions with like S1000D and DITA functions in SCORM 2.0 suitable for a CoP.*

Substituting generic SCORM 2004 functions with like S1000D and DITA functions creates CoP *profiles* of SCORM 2.0. A profile tailors SCORM 2.0 to the business practices required by a CoP through the adoption of functions provided in a data specification. Any data specification with like SCORM 2004 functions can be used to make a SCORM 2.0 profile. **Table 2** compares SCORM 2004 functions with S1000D and DITA functions.

Function	S1000D - DITA	SCORM 2004
Aggregation	S1000D - PubModule, scormContentPackage DITA – DITA Maps	IMS Content Packaging
Sequencing	S1000D - Process Data Module DITA – DITA Maps	IMS Simple Sequencing
Granularization and Reuse	S1000D - Data Modules DITA - Topics	Sharable Content Objects
Meta Data	S1000D - <idStatus>, <pmStatus>, <scormContentPackageStatus> DITA – DITA meta data	Learning Object Metadata (Institute for Electronics and Electrical Engineers, LOM)
Content	S1000D/DITA - Learning Data Modules	**No reference to content and format**
Reporting and Interfacing	**S1000D/DITA - Data and communication protocol not specified**	IEEE ECMA Script API for Content-to-Runtime Services Communication

Table 2: Alignment of SCORM 2004 to S1000D and DITA Functionalities

6.2.2.1. How S1000D and DITA functions will support data readiness and human performance in SCORM 2.0:

1. Aggregations contain CoP metadata that configures learning content to products.
2. Aggregation metadata will remain in the SCORM 2.0 content package throughout life cycle.
3. Required changes to learning content can be identified in CoP aggregation metadata.
4. LOM is now featured in S1000D and DITA.
5. Sequencing is achieved through specific linking that supports CoP activities such as trouble shooting.
6. SCORM 2.0 API can be expanded to track on-the-job human performance measures.

S1000D and DITA aggregations are the most likely first candidate for use as a substituted SCORM 2004 function. They do not support the conformance test suite (CTS) or the runtime environment. A functional gap analysis must be performed and change requirements must be identified for the aggregation models and the CTS to work together.

6.2.3. **Requirement #3**: **Integrate SCORM-based learning content development editors with common source databases.**

Solution to SCORM 2.0 Requirement #3: *Develop and reference a new API that enables learning content development tools access to S1000D and DITA content in common source databases (CSDBs). API will also support CSDBs to compile S1000D and DITA content into SCORM 2.0 content packages.*

The absence of naming and format guidelines in SCORM 2004 for technical learning content highlights how the reference model does not prepare learning organizations for life cycle logistics processes. S1000D can now serve as a common digital data format and support data readiness for all product-support documentation, including training. The harmonization between S1000D and SCORM 2.0, and DITA and SCORM 2.0 are opportunities to improve how technical data and learning content are managed and produced in a singled-hosted environment.

Figure 3 illustrates how SCORM 2.0-based learning content development tools could access to "S1000Databases" and "DITAbases". The CSDBs will compile SCORM 2.0 content packages. These opportunities must be supported according to interoperability principles: a communication protocol should exist between learning content development tools and databases, and between CSDBs and SCORM 2.0 compile tools.
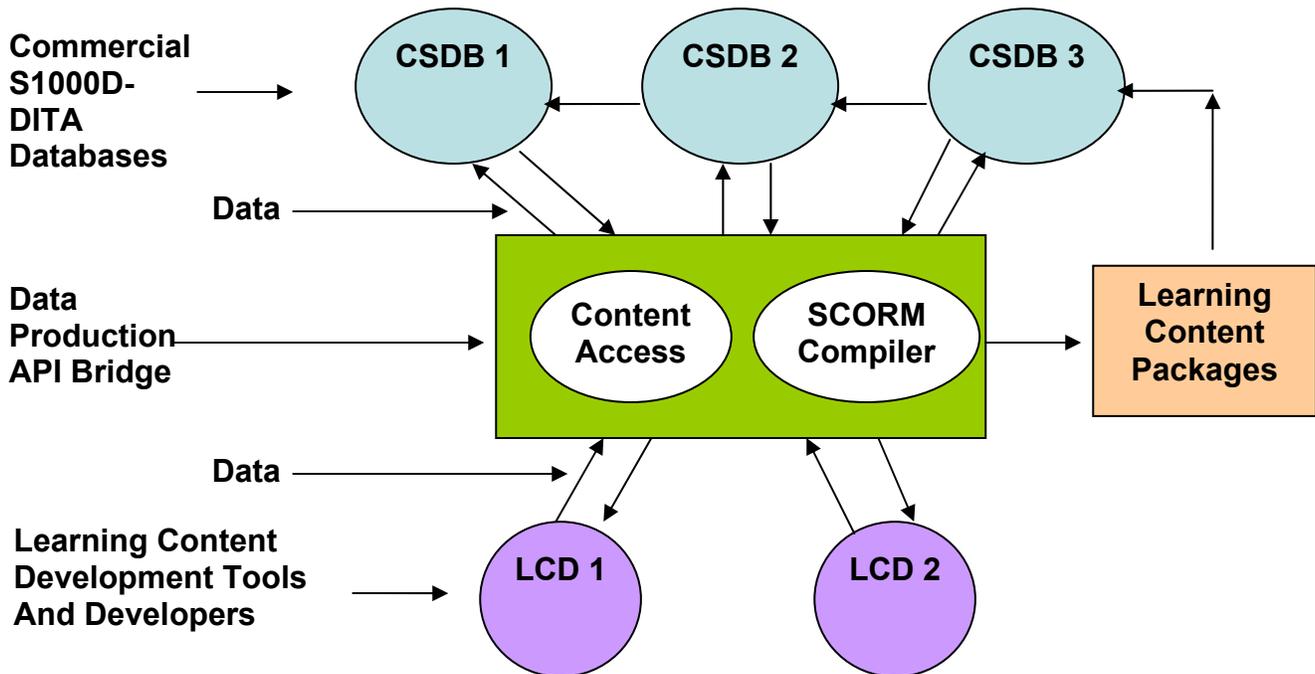
Figure 3: Sample S1000D-SCORM Production Framework

6.2.3.1.   How a S1000D and DITA data production API Bridge will support data readiness and life cycle logistics:

1. Learning content developers will leverage existing S1000D and DITA CSDB tool functionality such as version control, file naming, workflow and security.
2. Learning content developers will have direct reuse access to authoritative source information.
3. Learning content developers can create new content as other data developers are creating related content in the same environment.
4. Classroom instructors will be relieved of managing content anomalies between current authoritative source materials and outdated learning content.
5. S1000D and DITA CSDBs can compile SCORM 2.0 packages and output related information products from a CSDB.
6. Data managers can reduce their technical footprint and licensing costs by consolidating families of content and functionalities into a CSDB.

7.0 Summary

7.1. SCORM 2004 does not lend itself to data readiness and life cycle logistics support. SCORM 2.0 is an opportunity to solve real learning content management problems that cause instructors and logisticians extra work in ensuring content is current. Divorcing the production of learning content from its family of product support information is a broken business practice.

7.2. Referencing S1000D and DITA as optional data specifications into SCORM 2.0 will bring immediate control to learning content management. It will provide the opportunity to extend CoP metadata to help support life cycle processes and help provide critical naming convention practices central to product configuration. Referencing data specifications help develop SCORM 2.0 profiles. SCORM 2.0 can leverage data specification functions besides content models such as aggregation models. Harmonization will be realized when a production API will allow learning content developers access to CSDBs, and will allow CSDBs to compile data into SCORM 2.0 content packages.

7.3. Life cycle logistics is a multi-layered eco-system. Elements include products, requirements, designs, production processes, delivery, instruction, learning and performance. Referencing CoP data specifications into the distributed learning environment will make possible data and learner readiness through Performance*SCORM*.