SCORM®

Sharable Content Object Reference Model

SCORM 2004 Overview

JANUARY 30, 2004

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Advanced Distributed Learning (ADL)

Sharable Content Object Reference Model (SCORM®)

2004 Overview

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SECTION 1
SCORM 2004 Overview

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1.1. About This Document

The Department of Defense (DoD) and the White House Office of Science and Technology Policy (OSTP) launched the Advanced Distributed Learning (ADL) Initiative in November 1997. The mission of the ADL Initiative is to provide access to the highest quality education and training, tailored to individual needs, delivered cost-effectively anytime and anywhere. The ADL Initiative aims to accelerate large-scale development of dynamic and cost-effective learning software and systems and to stimulate the market for these products. This will help meet the expanding education and training needs of government, academia and industry.

As a foundation for accomplishing those goals, ADL's Sharable Content Object Reference Model (SCORM) aims to foster creation of reusable learning content as "instructional objects" within a common technical framework for computer and Web-based learning. SCORM describes that technical framework by providing a harmonized set of guidelines, specifications, and standards based on the work of several distinct e-learning specifications and standards bodies. These organizations continue to work with ADL, developing and refining their own e-learning specifications and standards and helping to build and improve SCORM.

This document provides an overview of the SCORM document suite, covering its roots, vision, aims and goals. It is intentionally written at a high-level. The technical details of SCORM can be found in three stand-alone documents, or books that cover the Content Aggregation Model (CAM), the Run-Time Environment (RTE) and Sequencing and Navigation (SN).

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1.2. SCORM 2004 Introduction

SCORM 2004 continues to build upon a common Web-based “Content Aggregation Model” and a “Run-Time Environment” for learning content. SCORM continues to build up its collection of specifications and standards adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content.

SCORM 2004 introduces many changes from past SCORM versions. These changes fall in to several categories: clarifications of concepts, clarification of requirements, changes due to standardization/specification efforts, best practices from the ADL community, enhancements and bug fixes.

One of the primary forces behind changes to SCORM has been the evolution of the underlying specifications and standards in SCORM 2004:

- IEEE Data Model For Content Object Communication
- IEEE ECMAScript Application Programming Interface for Content to Runtime Services Communication
- IEEE Learning Object Metadata (LOM)
- IEEE Extensible Markup Language (XML) Schema Binding for Learning Object Metadata Data Model
- IMS Content Packaging
- IMS Simple Sequencing

With the release of SCORM 2004, ADL has decided to change the versioning of SCORM so that each book can be maintained independently. The number of specifications and the sheer size of the documents have made this change necessary to manage revisions and corrections to the document set. Each of the SCORM books now carries their own version starting with this release (for historical purposes) at “Version 1.3”. Changes in the future will apply only to the affected book and will only affect that book’s version number.

This *SCORM Overview* will be updated to reflect the current versions of the other SCORM books as they evolve and will serve as the reference point for the overall versioning of SCORM as a whole. This document ties together the component documents that comprise SCORM 2004. Figure 1.2a: *SCORM Evolution* below illustrates the evolution of SCORM:

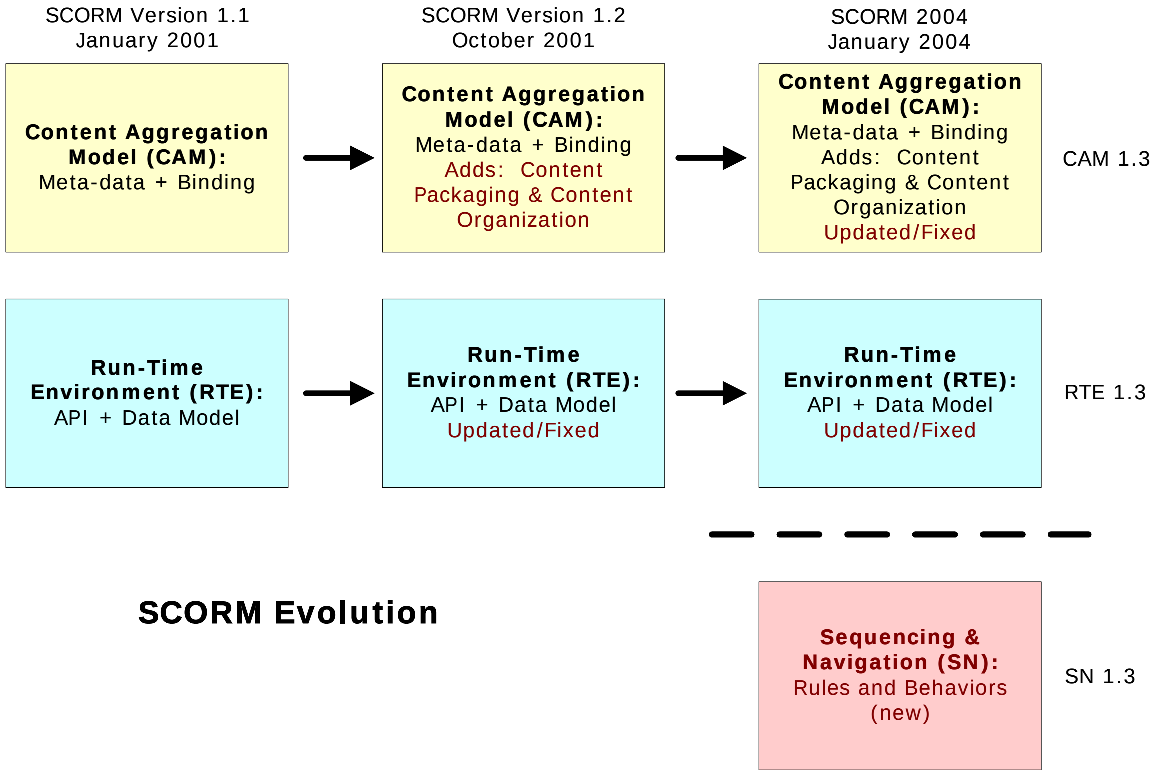

Figure 1.2a: SCORM Evolution

A more detailed description of the contents of those documents can be found in *Section 1.6 The Organization of SCORM*.

1.2.1. Thanks to Key Contributors

There are many people from government, academia and industry working within standards bodies such as the Alliance of Remote Instructional Authoring & Distribution Networks for Europe (ARIADNE), Aviation Industry CBT Committee (AICC), IMS Global Learning Consortium, Inc. the (IMS), the Institute of Electrical and Electronics Engineers (IEEE) and others who have helped realize the ADL Initiative's goals and objectives via their important contributions to the evolution of SCORM. While those who have contributed to SCORM are so numerous all of them cannot be mentioned here, certain individuals made pivotal contributions to the development process. Sincere thanks are owed to the following people whose assistance proved critical to the creation of SCORM:

Eddy Forte and Erik Duval (ARIADNE): For their continuing contribution of Learning Object Metadata (LOM) specifications submitted from ARIADNE to IEEE since 1997.

Wayne Hodgins (Autodesk): For chairing the IEEE Learning Technology Standards Committee (LTSC) Learning Objects Metadata Working Group and bringing the meta-data specification to maturity.

Jack Hyde (AICC/FlightSafety Boeing Training International): For his efforts to evolve the AICC Computer Managed Instruction (CMI) guidelines (i.e., CMI001 Guidelines for Interoperability [4]) to meet Web-based requirements and submitting the harmonized results to IEEE.

Claude Ostyn (Click2learn, Inc.): For developing a common launch and Application Programming Interface (API) Adapter proposal that formed the basis of SCORM/AICC Run-time Environment.

Tyde Richards (IBM Mindspan Solutions): For chairing the IEEE LTSC CMI Working Group and bringing the IEEE Draft Standard for Learning Technology - ECMAScript Application Programming Interface for Content to Runtime Services Communication and IEEE Draft Standard for Learning Technology - Data Model for Content Object Communication to maturity.

Robby Robson (Eduworks): For chairing the LTSC and harmonizing the work of IEEE with IMS, ARIADNE, ADL and many others.

Ed Walker (IMS): For his effort to include participation and inclusion of work from other groups and creating a collaborative environment within IMS.

Kenny Young (Microsoft): For working with ADL, AICC and IMS to develop a single content packaging scheme that harmonizes the requirements for all groups.

Again, these key names represent a fraction of the many contributors to SCORM. All participants worked hard to create consensus and develop solutions to difficult problems. Hours of hard work and meetings continue to produce a substantial and growing body of work that is the SCORM.

1.2.2. SCORM and Other Standards Activities

As discussed throughout this document, SCORM references specifications, standards and guidelines developed by other organizations and adapted and integrated with one another to form a more complete and easier-to-implement model. Before the ADL Initiative's work with standards activities began, an implementation model did not exist in a form that effectively met ADL high-level requirements. ADL continues to work with these organizations and relies on their processes for specification development and industry ratification. ADL's role involves contributing technical ideas and concepts and integrating and testing these specifications and standards, helping bridge the gap between their early stage development and their widespread adoption by industry.

Of the many organizations working on specifications related to e-learning, four in particular are key to SCORM. While ADL may not incorporate all of the work from these organizations, as some information is out of the scope of SCORM, these organizations play a vital role in the formation of next-generation learning technologies. ADL encourages active participation in one or more of these organizations in support of future specification development. The organizations along with their respective contact information are listed in Table 1.2.2a.

Organization	Contact Information	World Wide Web
ARIADNE [12]	Mme M. Rittmeyer or M. E. Forte Phone: +41-21 693 6658 / 4755 Fax: +41-21 693 4770 ariadne@ariadne-eu.org	http://www.ariadne-eu.org/
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IMS [3]	Lisa Mattson lisa@imsproject.org Phone: (919) 462-6268 Edward Walker, Ph.D., Chief Executive Officer ewalker@imsproject.org Phone: (978) 312-1082	http://www.imsglobal.org/

Table1.2.2a: Specifications and Standards Contact Information

1.3. ADL History and Overview

Developments in e-learning that are linked to and affected by education and training trends in industry, academia, government and the military spurred the launch of the ADL Initiative. This section briefly discusses the history of e-learning as it relates to ADL, describing studies and movements associated with ADL's inception.

1.3.1. The Value of Instruction Tailored to the Individual

The drive to use technology to enhance learning began with research into how people learn, and specifically, how they learn most effectively and efficiently. Learning research has been conducted for many years and often finds that effectively using information technology can enhance learning experiences while improving efficiency and reducing costs.

This research, however, often started not with technology, but by analyzing which approaches to instruction are most effective. Studies comparing classroom learning to individually tailored instruction (i.e., tutoring) provide an example. These studies show:

- The speed with which different individuals can progress through instruction varies by factors of three to seven – even in classes of carefully selected students [8].
- On average, a student in classroom instruction asks about 0.1 questions an hour [9].
- In individual tutoring, providing increased opportunities for direct student-to-instructor communication, students may ask or answer as many as 120 questions per hour [9].
- The achievement of individually tutored students may exceed that of classroom students by as much as two standard deviations – an improvement that is roughly equivalent to raising the performance of 50th percentile students to that of 98th percentile students [10].

Individually tailored instruction sometimes offers ideal learning outcomes. But as a training strategy in government, academia or industry, environments, individually tailored instruction involving one-on-one attention is often too costly and logistically challenging.

Using information technology in instruction may solve this problem because its capabilities for real-time, on-demand adaptation can provide individualized instruction at affordable cost and apply consistent content that reliably leads to objectively measurable learning outcomes. Consequently, empirical studies have raised national interest in employing education and training technologies that are based on the increasing power, accessibility and affordability of information technologies. These studies have found that, in contrast to classroom learning, information technologies can adjust the pace, sequence, content and method of instruction to better fit each student's learning style, interests and goals [11]. However, that realizing the promise of improved learning efficiency even through the use of the most current instructional technologies—such as Web-based instruction, interactive multimedia instruction and Intelligent Tutoring Systems (ITS)—still depends on the ability of those technologies to sufficiently tailor quality and appropriate instruction to the needs of individuals.

In short, the one-on-one individualization capabilities of technology-based instruction, in contrast to one-on-many classroom-based instruction, may approximate and perhaps exceed the effectiveness of one-on-one tutoring.

This adaptability to individual learners and their needs can be seen in several categories of e-learning products, but is perhaps best exemplified in ITS.

1.3.2. Intelligent Tutoring Systems (ITS)

As illustrated in Figure 1.3.2a, groups of researchers began to explore the greater potential of "information structure-oriented" approaches to represent human cognition and learning in the late 1960s [14]. Rooted in early artificial intelligence studies, the study of how human beings learn, master skills and define subject domains eventually led to the development of a new approach now called ITS.

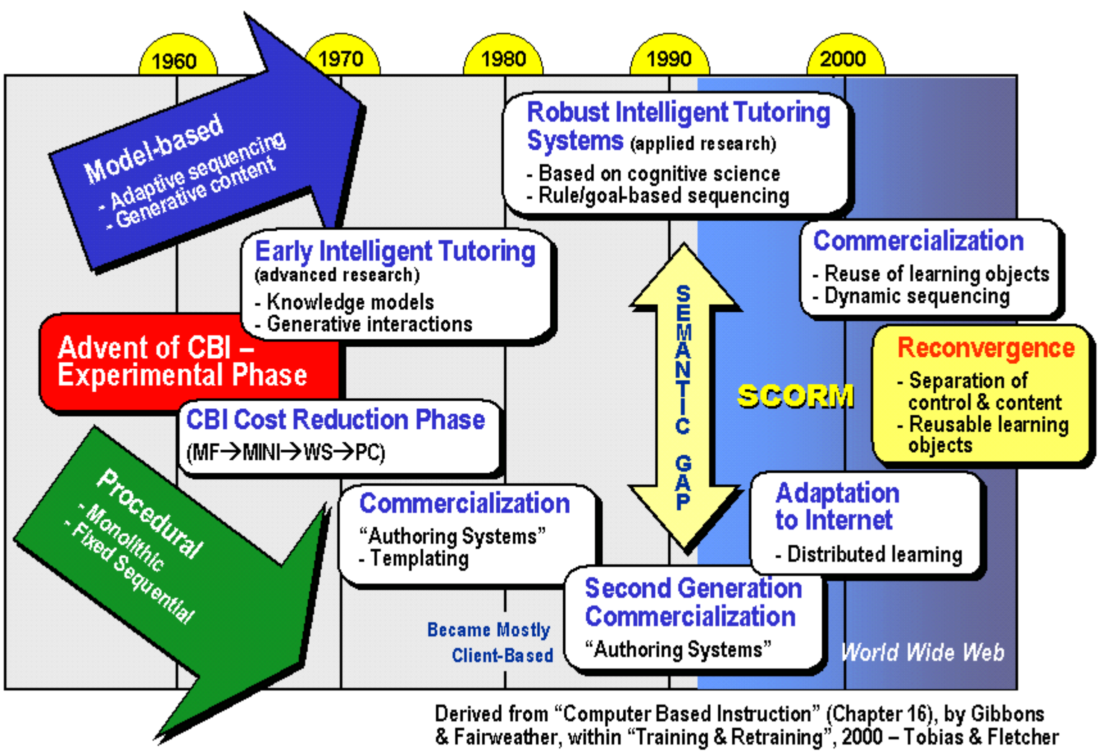

Figure 1.3.2a: The Evolution of E-learning[13]

"Intelligent" in the context of ITS refers to the specific functionalities that are the goals of ITS development. These functionalities are distinct from those found in more conventional approaches to Computer-Based Instruction (CBI). They require ITS to:

- Generate instruction in real time and on demand as required by individual learners, and
- Support mixed initiative dialogue, allowing free form discussion between the technology and the student or user.

Several factors have in the past hindered the development of ITS technologies [15]. First, the science of human cognition was relatively immature in the early days of computing – especially in terms of computer modeling. Second, complex modeling and rule-based systems require (then and now) considerable computing power. Subsequent advances in both computer technology and cognitive science have provided a foundation for the development of ITS technologies [16].

ITS development will be further aided when learning content in the form of instructional objects become widely available. As these objects are created, and especially as the collective pool of these reusable resources expands, they can be labeled for subsequent discovery, selection and assembly in real time, on demand as suggested by Figure 1.3.2.b. This is often referred to as the "A" in ADL.

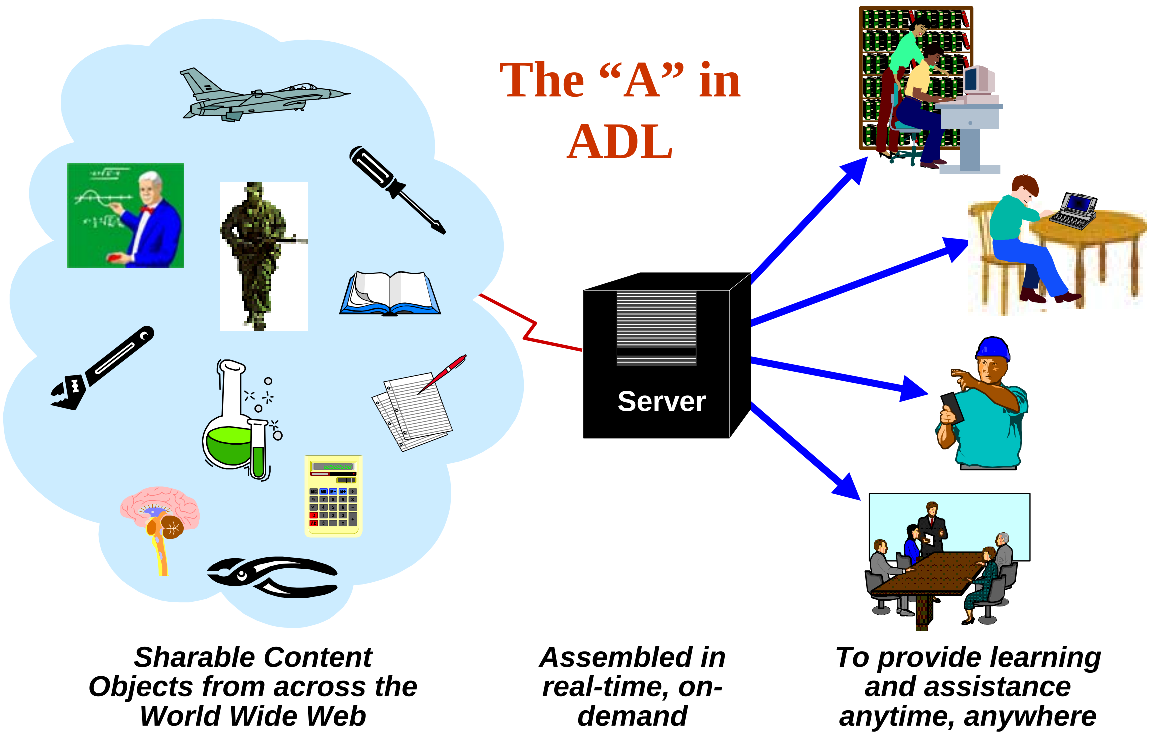

Figure 1.3.2b: The ADL Initiative Vision

This generative work is the job of the server, represented as a black box in the middle of the figure. By relying upon logic embedded in content packaging or instructional strategy objects, the server may acquire the capabilities of intelligent tutoring/decision-aiding systems and achieve tailored adaptive instruction.

The development of ITS and the ADL Initiative's long-term vision, then, have a number of key goals in common:

- Both are generative in that they envision the assembly and presentation of learning content on demand, in real time;
- Both are intended to tailor content, sequence, level of difficulty, level of abstraction, style, etc. to users' intentions, background, and needs;
- Both have a stake in research intended to accomplish such individualization;
- Both can be used equally well to aid learning or decision making;
- Both are intended to accommodate mixed initiative dialogue in which either the technology or the user can initiate or respond to inquiries in natural language; and
- Both will benefit greatly from a supply of sharable instructional objects readily available for the generation of instructional (or decision aiding) presentations [19].

1.3.3. Evolution of E-Learning

As briefly discussed in *Section 1.3.2 Intelligent Tutoring Systems (ITS)*, advances in CBI took place concurrently with progress in ITS. CBI technologists split into two "natural" groups early on: applied scientists (engineers), and advanced researchers. The engineers followed the evolutionary chain of computer development and exploited its advancements. This concept is shown in Figure 1.3.2a. The relatively crude early-stage instructional languages evolved into more complex development tools that abstracted the underlying implementations into widely usable interfaces. These allowed an increasingly large class of non-programmers to create learning content more rapidly than ever. Development costs were reduced and improved effectiveness was demonstrated, establishing a sustainable industry of products and services [17].

CBI researchers and engineers in the first group continued to refine tools to include complex instructional constructs in the form of instructional templates or frames. These templates descend directly from more foundational programming techniques, but shield instruction designers from the complexities of computer coding. Templates are, nonetheless, procedural in structure and nature.

As CBI tools matured and personal computers proliferated, the cost of developing CBI plummeted. Instructional content incorporated rich multimedia capabilities and authoring systems provided sophisticated feature sets. But these proprietary and specialized client-based systems produced learning content that could not be easily used outside of its original context or without the presence of the tools in which it was created. Instructional content and the logic that sequenced it for presentation to the end user were tightly bound together.

Meanwhile, advanced researchers in the second group continued developing ITS prototypes. Their concept of instructional content and design was fundamentally different from CBI tool designers. They sought to generate instructional experiences and presentations closely tailored to the needs of individual learners using sophisticated models of the learner, the subject matter and tutorial techniques. Such approaches tended to separate sequencing control logic from instructional content and allowed the concept of dynamically assembling learning objects to meet specific learning objectives to take root.

1.3.4. Influence of the World Wide Web

The advent of the World Wide Web changed CBI and ITS in unanticipated and unexpected ways. As it developed, the World Wide Web provided a widely accessible communications structure built on common standards that provided easy access, anytime and anywhere, to information and knowledge.

Architecturally, the World Wide Web was initially incompatible with many CBI authoring system designs. Web content was platform neutral and stored and managed by a remote server, whereas most CBI content was stored and executed locally using private script languages processed by proprietary run-time software engines. Nonetheless, the CBI community was quick to see the long-term benefits of Web-based instruction.

1.3.5. The Transition to Web-Based Learning

The first stages of conversion from stand-alone CBI to Web-based learning content were direct adaptations of existing products from CD-ROM to online delivery. The Web was used initially as little more than a replacement distribution medium. Content was still monolithic (i.e., designed to address one specific set of learning objectives as a contiguous whole, and not easily broken into components with significant reuse potential). In some ways early Web-based content was still held captive to its contextual and development environments. To render content, users were required to download proprietary browser plug-ins to process discrete content display formats. In terms of the ability to "flex" in situations in which reuse was of value, early Web-based learning content remained brittle, still dependant on proprietary sequencing and navigation solutions that did not necessarily work consistently in multiple environments [18].

Second-generation Web-based authoring systems began to more fully embrace the idea of separating content and the logic controlling the display and presentation of that content as the potential for robust server-based Learning Management Systems (LMSs) became evident. For the first time, mainstream CBI authoring tool developers began to embrace concepts similar to those of the ITS community. Reusable, sharable learning objects and adaptive learning strategies became common ground between the CBI and ITS communities.

1.3.6. What SCORM Enables

Just as the Web became ubiquitous and government, academia, industry and other elements of society embraced it as having deep potential for efficient distributed learning, the standardizing work of SCORM entered the picture as a key component of ADL. SCORM, borrowing from previous work of other specifications and standards activities such as those mentioned earlier, put together a model for creating and deploying e-learning that assumed the presence of strong, server-side, LMS-based learning content distribution.

SCORM targets the Web as a primary medium for delivering instruction. It does so under the assumption that anything that can be delivered by the Web can be easily used in other instructional settings that make fewer demands on accessibility and network communications. This strategy eliminates much of the development work once needed to adapt to the latest technology platform because the Web itself is becoming a universal delivery medium. By building upon existing Web standards and infrastructures, SCORM frees developers to focus on effective learning strategies.

The development of SCORM continues, even as the main medium it targets, the Web, continues to evolve and change. SCORM currently provides an Application Programming Interface (API) for communicating information about a learner's interaction with content objects, a defined data model for representing this information, a content packaging specification that enables interoperability of learning content, a standard set of meta-data elements that can be used to describing learning content and a set of standard sequencing rules which can be applied to the organization of the learning content. While the technical standards used by the Web turn out to work equally well locally, regionally and globally, when it comes to the standardization of e-learning itself, the task of SCORM, is continuing to evolve.

As SCORM continues to develop the technical foundations of e-learning via standardization, researchers from both the CBI and ITS communities are focusing their attention on similar issues:

- Defining reusable learning objects
- Developing new content models
- Developing learner assessment models
- Creating new models for sequencing content
- Creating learning "knowledge" repositories.

Each of these topics drives the requirements for new specifications that will build upon and expand existing work such as SCORM.

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1.4. The ADL Co-Laboratory Network

Executive Order 13111, “Using Technology to Improve Training Opportunities for Federal Government Employees,” [7] tasked the DoD to take the lead in working with other federal agencies, academia and industry to develop common specifications for technology-based learning to help meet national education and training needs and provide best practice guidance to other federal agencies. Accordingly the DoD established the Alexandria Advanced Distributed Learning (ADL) Co-Laboratory (Co-Lab) in Alexandria, Virginia in 1999 to provide a forum for collaborative exchange and technical support in developing and assessing prototypes, tools and learning content for the ADL Initiative[5]. The work of Executive Order 13111 was continued under Executive Order 13218, “21st Century Workforce Initiative” [20].

The Alexandria ADL Co-Lab houses a number of DoD activities and operates as the organizational host for federal agency sponsors and project managers. It is intended to stimulate development of knowledge management systems and technologies that enhance learning and performance across the DoD and other Federal agencies. Since the establishment of the ADL Alexandria Co-Lab, the Department of Labor (DOL) and the National Guard Bureau (NGB) have joined the Alexandria ADL Co-Lab as “contributing sponsors”. These organizations are coordinating resources and projects with the ADL Initiative and moving their learning content toward SCORM conformance.

Three ADL Co-Lab nodes have been established. The Joint ADL Co-Lab in Orlando, Florida promotes collaborative development of ADL prototypes and ADL systems, principally among DoD components and the Military Services. The Academic ADL Co-Lab in Madison, Wisconsin was established in partnership with the University of Wisconsin and the Wisconsin Technical College System to promote collaborative development, demonstration and evaluation of next-generation learning technologies for distributed learning in academia. The Workforce ADL Co-Lab was established in Memphis, Tennessee by an agreement between the ADL Co-Lab and the University of Memphis FedEx Institute for Technology to promote and disseminate ADL technologies in business and industry and to identify best practices for ADL implementations in the private sector.

All four ADL Co-Labs work together to share research, subject-matter expertise, common tools and course learning content through the ADL Co-Lab Network.

In addition, ADL has established two ADL Partnership Labs in the United Kingdom and Canada. The UK ADL Partnership Lab was established in collaboration with the Learning Laboratory at the University of Wolverhampton in Telford, England. Its primary objective is to promote development and implementation of global e-learning standards. The Canadian ADL Partnership Lab in Ottawa, Ontario is a collaboration with the Department of National Defence of Canada (DND), represented by the Director of Training and Education Policy (DTEP). It will promote and share research and lessons learned on the application of SCORM and related learning technologies as well as on technical evaluation and SCORM conformance testing.

The ADL Technology Center in Johnstown, Pennsylvania works with all of the ADL Co-Labs to develop and validate SCORM concepts, technologies and utilities.

Further, ADL has established a cooperative and collaborative relationship with the Center for Research on Evaluation, Standards and Student Testing at the University of California at Los Angeles, to develop and apply techniques for evaluating the cost and effectiveness of distributed learning.

Figure 1.4a portrays the ADL Co-Lab Network concept of operations.

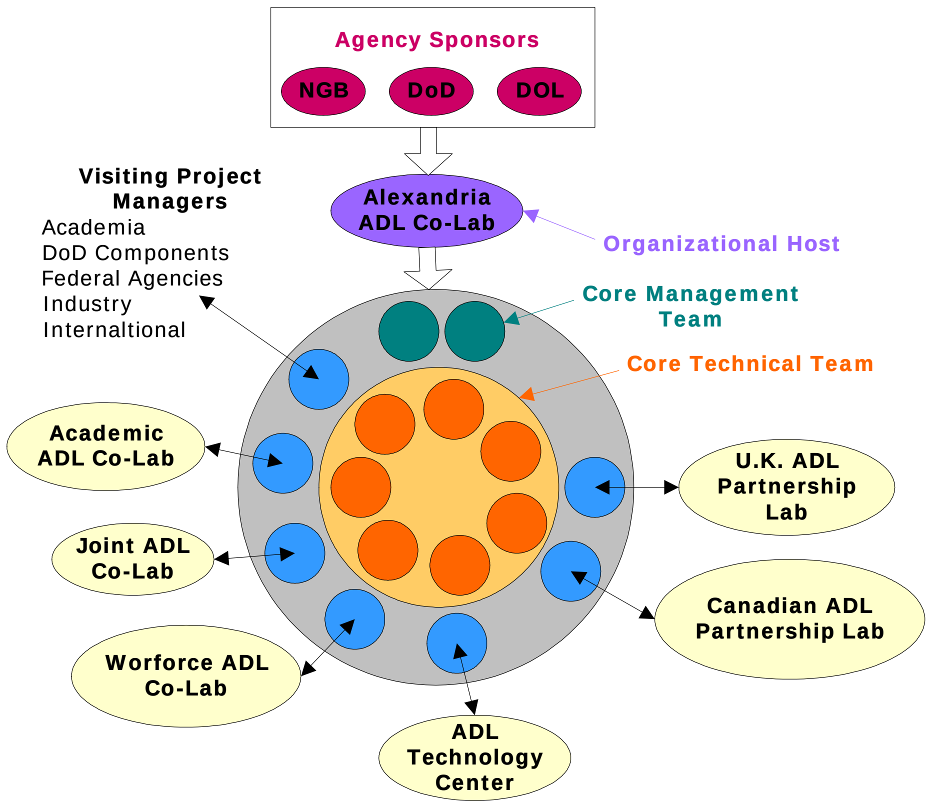

Figure 1.4a: ADL Co-Laboratory Concept of Operations

The ADL Co-Lab Network will help determine how learning technologies can be designed to bring about specific, targeted instructional outcomes reliably within as wide a range of instructional settings as possible. It will develop effective methods to perform the following tasks:

- Tailor pace, content, sequence, and style of instruction to the needs of individual learners – taking advantage of their strengths and concentrating on areas where they need help.
- Integrate technology within existing instructional institutions and determine what changes are needed for these institutions to maximize return on investments in technology.
- Coordinate education and training with the performance aiding capabilities provided by ADL.

- Design new instructional techniques, such as intelligent tutoring, tutorial simulations, virtual reality, and networked simulation and games that take full advantage of the capabilities technology brings to instruction.
- Assess the costs and effectiveness of instructional programs.
- Measure and verify the capabilities and performance of learners.

With specific regard to SCORM, the ADL Co-Labs are testing and evaluating ADL products to determine how well they meet user requirements for reusability, accessibility, durability, interoperability, and cost-effectiveness. These evaluations concern the following areas:

- Ability to move Web-based content from one learning environment to another
- Reuse of learning content across different platforms and learning environments
- Creation of learning content that are searchable and "discoverable" across different learning applications and media repositories
- Tools for producing and using SCORM conformant learning content

To coordinate all these activities, ADL has organized "Plugfest" events that bring together e-learning stakeholders in government, academia, and industry and afford them the opportunity to share lessons learned in becoming SCORM conformant, demonstrate the interoperability and reusability of their ADL prototypes and tools and to refine and update SCORM.

Beyond SCORM, the ADL Co-Lab Network is fostering the development, dissemination, and maintenance of guidelines to facilitate resource sharing across government, academia, and industry. These guidelines will include use of instructional development tools, design and development strategies, and evaluation techniques.

The ADL Co-Labs Network serves as a hands-on showcase and clearinghouse both for ADL demonstrations and products that meet SCORM criteria and for distributed learning technologies, prototypes and projects in general. More information is provided at ADLNet.org.

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1.5. Introduction to SCORM

ADL architects recognized early the need for a reference model that would specify learning content and its labeling, storage, and presentation in distributed learning. The SCORM as described in the sections that follow, represents a coordinating model intended to give e-learning a collection of standard practices that can be generally accepted and widely implemented.

1.5.1. SCORM's Role in ADL and the E-Learning Industry

SCORM helps define the technical foundations of a Web-based learning environment. At its simplest, it is a model that references a set of interrelated technical standards, specifications and guidelines designed to meet high-level requirements for learning content and systems. SCORM describes a "Content Aggregation Model," "Run-Time Environment " for learning objects to support adaptive instruction based on learner objectives, preferences, performance and other factors (like instructional techniques).

SCORM also attempts to knit together disparate groups and interests in the distributed learning community. It is intended to coordinate emerging technologies and capabilities with commercial/public implementations.

A number of organizations have been working on different but closely related aspects of e-learning technology. These organizations have made great strides in their separate domains, but they have not been well connected to one another. Some of their specifications are general, anticipating a wide variety of implementations by various user communities (e.g., those using the Web, CD-ROMs, interactive multimedia instruction or other means to deliver instruction) and others are rooted in earlier practices and require adaptation to newly emerging approaches.

With SCORM, ADL has worked with many organizations and the ADL community of implementers to build a common "reference model" for the foundation of Web-based learning. Years of experimentation and testing of applications based on SCORM confirm that it is now a stable model that goes a long way to achieving most of the ADL :"ilities", but the scope of SCORM is still not all-inclusive. Some aspects of e-learning remain to be addressed by SCORM. ADL developers will expand the scope of SCORM over time to reflect experience gained and lessons learned through implementation and deployment, as well as feedback from the broader e-learning community.

1.5.2. The "ilities" – Conceptual Starting Point for SCORM

There are three primary criteria for a reference model such as SCORM. First, it must articulate guidelines that can be understood and implemented by developers of learning content. Second, it must be adopted, understood and used by as wide a variety of stakeholders as possible, especially learning content and tool developers and their customers. Third, it must permit mapping of any stakeholder's specific model for instructional systems design and development into itself. Stakeholders must be able to see how their own model of instructional design is reflected by the reference model they hold in common.

Up-front investment is required to develop and convert learning content for technology-based presentation. These investment costs may be reduced by an estimated 50-80 percent through the use of learning content that is accessible, interoperable, durable and reusable.

Procedures for developing such learning content are state-of-the-art in e-learning, but they must be articulated, accepted and widely used as guidelines by developers and their customers. These goals can be achieved through collaborative development. Collaboration will increase the number, quality and per unit value of learning content made available. Such collaboration requires agreement upon a common reference model.

To help stimulate industry agreement and to realize such a model, SCORM adapts the object properties listed above into high-level requirements for all SCORM-based e-learning environments. These requirements are known as ADL's "ilities," and they form the foundation on which all changes and additions to SCORM are based. These "ilities" are as follows:

> **Accessibility:** the ability to locate and access instructional components from one remote location and deliver them to many other locations.
>
> **Adaptability:** the ability to tailor instruction to individual and organizational needs.
>
> **Affordability:** the ability to increase efficiency and productivity by reducing the time and costs involved in delivering instruction.
>
> **Durability:** the ability to withstand technology evolution and changes without costly redesign, reconfiguration or recoding.
>
> **Interoperability:** the ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.
>
> **Reusability:** the flexibility to incorporate instructional components in multiple applications and contexts.

In addition to these "ilities," another foundational concept for SCORM is "the Web-based assumption", which asserts that the Web provides the best opportunity to maximize access to and reuse of learning content. ADL made this assumption for several reasons:

- Web-based technologies and infrastructure are rapidly expanding and provide a mainstream basis for learning technologies.
- Web-based learning technology standards do not yet exist in widespread form.

- Web-based content can be delivered using nearly any medium (e.g., CD-ROM, stand-alone systems and/or as networked environments).

The Web-based assumption embraces industry's transition to common content and delivery formats. Computer operating system environments now natively support Web content formats. The trend is toward the use of common formats that can be used locally, on local intranets or over the Web. SCORM extends this trend to learning technologies.

Combining the "ilities" with the Web-based assumption, SCORM's operational principles offer the following abilities:

- The ability of a Web-based LMS to launch content that is authored using tools from different vendors and to exchange data with that content.
- The ability of Web-based LMS products from different vendors to launch the same content and exchange data with that content during execution.
- The ability of multiple Web-based LMS products/environments to access a common repository of executable content and to launch such content.

A key function of an LMS in the ADL context, then, is to manage the run-time experience the learner has with the learning content.

1.5.3. Describing Learning Management Systems (LMSs)

The term "LMS" is a catchall term used throughout this document and SCORM. It refers to a suite of functionalities designed to deliver, track, report on and manage learning content, learner progress and learner interactions. The term "LMS" can apply to very simple course management systems, or highly complex enterprise-wide distributed environments. A highly generalized model showing potential components or services of an LMS is shown in Figure 1.5.3a. Many participants in the development of learning technology standards now use the term LMS instead of CMI so as to include new functionalities and capabilities not historically associated with CMI systems. These include, among other services, back-end connections to other information systems, sophisticated tracking and reporting of student activity and performance, centralized registration, online collaboration and adaptive content delivery – all services aimed at track and manage learner progress.

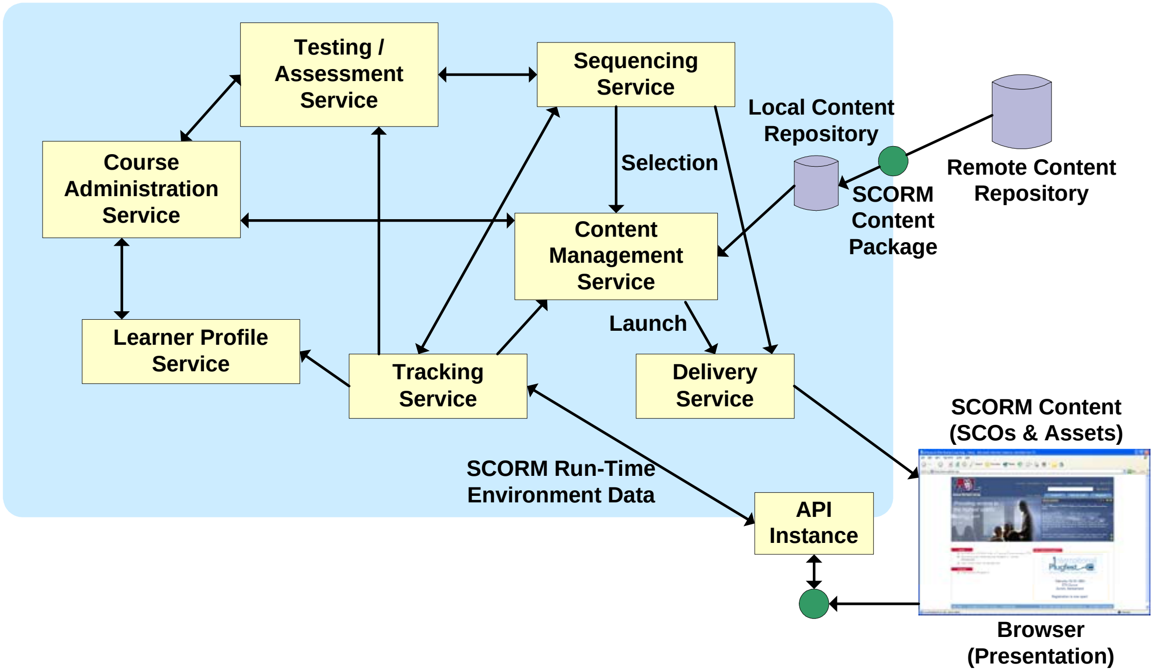

Figure 1.5.3a: Highly generalized model of an LMS

The term "LMS" is now being used as a superset description of many content and enterprise management capabilities. Within SCORM context, LMS implementations are expected to vary widely. SCORM focuses on interface points between content and LMS environments and is silent about the specific features and capabilities provided within a particular LMS.

In SCORM, the term LMS implies a server-based environment in which the intelligence for managing and delivering learning content to students resides. In other words, in SCORM, the LMS determines what to deliver and when, and tracks progress and performance as the learner moves through the learning content.

SCORM supports the notion of learning content composed from relatively small, reusable content objects aggregated together to form units of instruction such as courses, modules, chapters, assignments, etc. By themselves, content objects have no specific context. When combined with other instructional content objects, the aggregation provides the context and supports a defined learning experience. Content objects can thus be designed for reuse in multiple contexts.

This approach means that content objects do not determine by themselves how to sequence/navigate through an aggregation representing a unit of instruction. Doing so would require content objects to contain information about other content objects within a content organization, which would inhibit their reusability by limiting their use to one specific context. Instead, sequencing and navigation is controlled by rules defined within the aggregation and interpreted by the LMS. The LMS merely processes the externally defined rules and itself has no knowledge *per se* about how the content is organized except through the interpretation of rules defined in contents organizational structure. This allows the instructional content designer/developer to specify sequencing rules and navigation behavior while maintaining the possibility of reusing learning resources within multiple and different aggregation contexts. Thus by keeping the rules and navigation separate from and outside of content objects, the content may be reused in new and different ways to support many different instructional strategies.

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1.6. The Organization of SCORM

SCORM is a collection of specifications and standards that have been bundled into a collection of “technical books.” Each can be viewed as separate books gathered together into a growing library. Nearly all of the specifications and guidelines are taken from other organizations. These technical books are presently grouped under three main topics: the “Content Aggregation Model (CAM)”, the “Run-time Environment (RTE)” and “Sequencing and Navigation (SN),”.ADL anticipates including additional specifications in SCORM’s future.

SCORM integrates technology developments from groups such as IMS [3], AICC [1] , ARIADNE [12], and the IEEE LTSC [2] – within a single reference model to specify consistent implementations that can be used across the e-learning community.

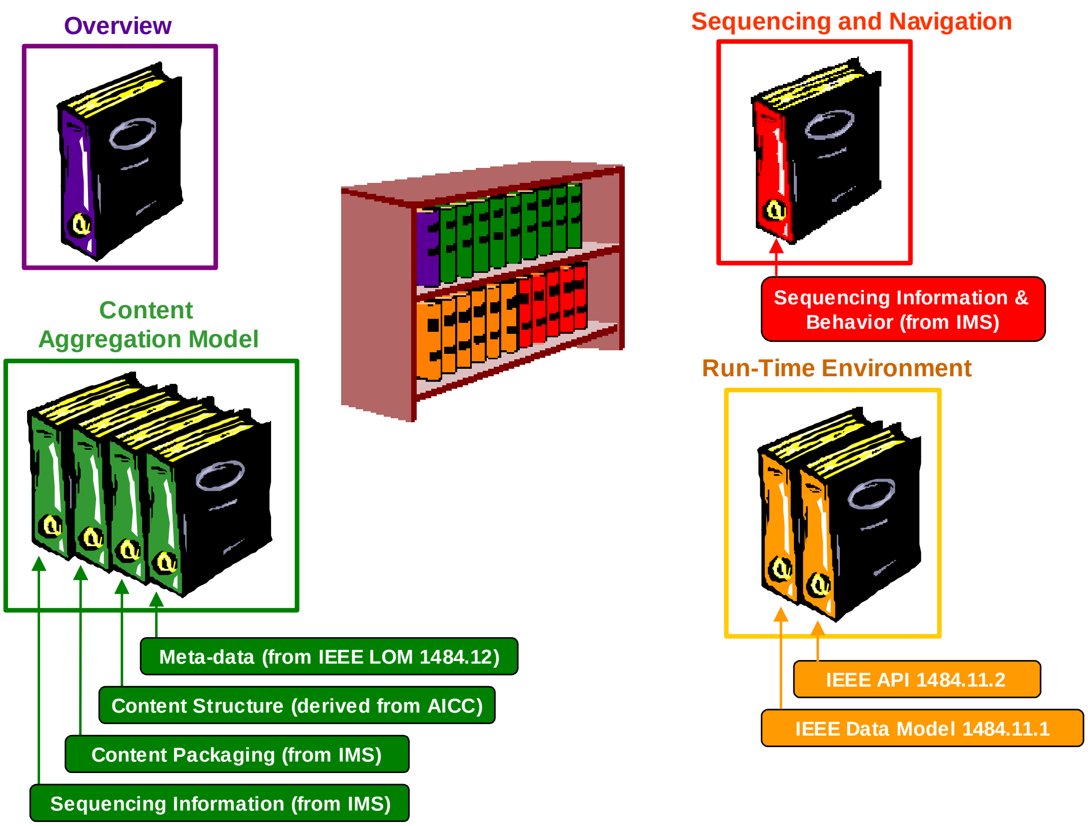

Figure 1.6a: SCORM Bookshelf

While the various SCORM books, focusing as they do on specific aspects of SCORM, are intended to stand alone, there are areas of overlap or mutual coverage. For instance, while the RTE book focuses primarily on communication between content and LMSs, it frequently refers to the types of content objects conducting that communication: Sharable Content Objects (SCOs). Their definition and a more detailed treatment of SCOs are found in the CAM book. Similarly, while the SN book covers the details of SCORM sequencing and navigation processes, to include specific coverage of how an LMS evaluates navigation requests and related activities, the RTE book deals with content delivery, and as such, gives high-level information on how an LMS determines which piece of content to deliver at any given time.

1.6.1. Individual Book Coverage Details

Table 1.6.1a summarizes each of the above books in table format.

SCORM Book	Concepts Covered	Key SCORM Technologies Covered	Areas of Overlap
Overview	High-level conceptual information	Introduction to numerous high-level elements of SCORM terminology.	Covers areas of the CAM, RTE, and SN books at a high-level.
Content Aggregation Model (CAM)	Assembling, labeling and packaging of learning content.	SCO, Asset, Content Aggregation, Package, Package Interchange File (PIF), Meta-data, Manifest, Sequencing Information, Navigation Information	SCOs and manifests. SCOs communicate with an LMS via the RTE. Manifests contain Sequencing and Navigation information.
Run-Time Environment (RTE)	LMS's Management of the Run-Time Environment which includes launch, content to LMS communication, tracking, data transfer and error handling.	API, API Instance, Launch, Session Methods, Data Transfer Methods, Support Methods, Temporal Model, Run-Time Data Model	SCOs are described in the CAM book, are content objects which use the RTE.
Sequencing and Navigation (SN)	Sequencing content and navigation.	Activity Tree, Learning Activities, Sequencing Information, Navigation Information, Navigation Data Model	Sequencing and Navigation affects how content is assembled in a manifest.

Table 1.6.1a: SCORM Book Coverage

1.6.1.1. The SCORM 2004 Overview Book

The SCORM 2004 Overview book covers the history and objectives of the ADL Initiative and SCORM, including the specifications and standards from which SCORM borrows. It also describes how the various SCORM books are related to one another.

1.6.1.2. The SCORM Content Aggregation Model (CAM) Book

The SCORM Content Aggregation Model (CAM) book describes components used in a learning experience, how to package those components for exchange from system to system, how to describe those components to enable search and discovery, and how to define the sequencing rules for the components. The CAM promotes consistent storage, labeling, packaging, exchange and discovery of content.

The SCORM CAM book also defines responsibilities and requirements for building content aggregations (e.g., course, lessons, modules, etc). The book contains information on creating content packages, applying meta-data to the components in the content package and applying sequencing and navigation details in the context of a content package. Several dependencies span from the SCORM CAM book to the SCORM RTE book.

SCORM meta-data describes the different components of the SCORM Content Model (Content Aggregations, Activities, SCOs and Assets). Meta-data, a form of labeling, enhances search and discovery of these components. At this time, there are no defined relationships between SCORM meta-data and SCORM RTE Model and SCORM meta-data has no impact on run-time behaviors or events. For these reasons, meta-data is not discussed in detail in the SCORM RTE book. It is anticipated, as SCORM evolves, that this relationship may change.

A Content Package, in a general sense, bundles content objects with a content organization that is described in a manifest. A SCORM Content Package may represent a course, lesson, module, or may simply be a collection of related content objects. The manifest, an essential part of all SCORM Content Packages, is defined as an Extensible Markup Language (XML)-based file named "`imsmanifest.xml`". This file, similar in many ways to a "packing slip", describes the contents of the package and may include an optional description of the content structure.

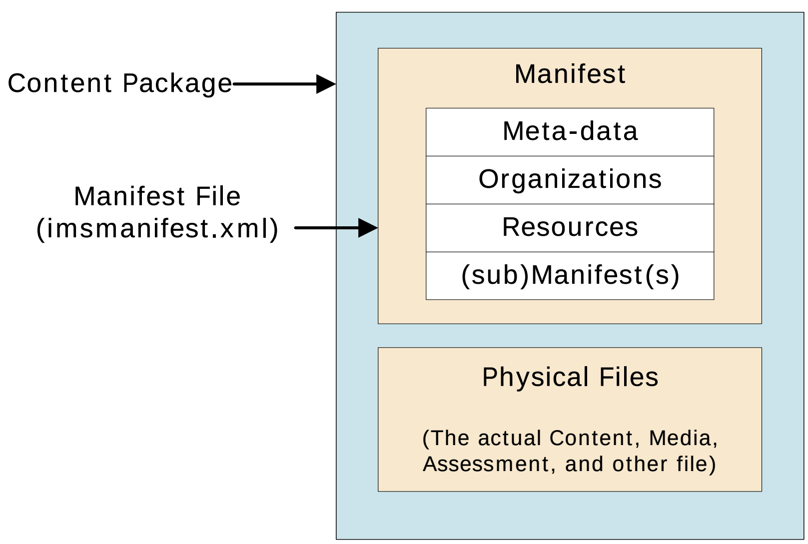

Figure 1.6.1.2a: Conceptual Content Package

SCORM Content Packages may include additional information that describes how an LMS is intended to process the Content Package and its contents. Some of these elements are utilized by SCORM RTE model.

- Content object launch locations and launch parameters are described as elements in SCORM Content Packages. The SCORM RTE book details these elements and their effects on launching content objects;
- Several elements in a SCORM Content Packages affect initialization and management of a content object's run-time data model. The SCORM RTE book details these elements and the required LMS behaviors.
- Other elements in SCORM Content Packages describe initial values for specific elements of a content object's run-time data model. The SCORM RTE book details these elements and their initialization behavior:
- When a SCORM Content Package includes a description of content structure, sequencing and navigation information elements may be added to define an intended approach to sequencing the package's content objects.

For a better understanding of how all of the elements described above are specified in a SCORM Content Package, refer to the SCORM CAM book.

1.6.1.3. The SCORM Run-Time Environment (RTE) Book

The SCORM RTE book describes the Learning Management System (LMS) requirements for managing the run-time environment (i.e., content launch process, communication between content and LMSs and standardized data model elements used for passing information about the learner)**.** The RTE covers the requirements of SCOs and their use of the API and the SCORM Run-Time Environment Data Model.

The purpose of the SCORM RTE is to provide a means for interoperability between SCOs and LMSs. SCORM provides a means for learning content to be interoperable across multiple LMSs regardless of the tools used to create the content. For this to be possible, there must be a common way to launch content, a common way for content to communicate with an LMS, and predefined data elements that are exchanged between an LMS and content during its execution. The three components of the SCORM RTE are defined as Launch, Application Program Interface (API), and Data Model. The technical details of these elements are described in SCORM RTE book, but a brief overview of each of these elements of the RTE follows.

Launch defines the relationship between LMSs and SCORM content so that all SCORM-conformant content relies on a SCORM-conformant LMS to be delivered and displayed to the learner. With SCORM 2004, LMSs have expanded responsibilities to determine which SCORM content is to be delivered next. These responsibilities, described in the SCORM SN book, are also touched on in the SCORM RTE book.

The SCORM API, as described in the SCORM RTE book, provides a set of predefined functionalities that are agreed upon by both LMS vendors and content authoring tool vendors to enable communication between an LMS and the SCOs it launches. These functionalities complete the launch process by establishing a "handshake" between the SCO and the LMS that launched it, and breaking that handshake when the SCO is no longer needed. In addition, they allow SCORM content to "set" and "get" data on the LMS, such as assessment results, and to check for and address any errors that occur during these processes.

The SCORM Run-Time Environment Data Model provides the vocabulary that can be used to pass information, or to "get" and "set" data from and to an LMS when calling SCORM API functions. For instance, when passing a test score from a learner, a SCO would use the SCORM Data Model element known as "`cmi.score.scaled`" to inform the LMS how the learner performed. This and all other SCORM Data Model elements are described in detail in the SCORM RTE book.

Various concepts described in the SCORM CAM have impacts on the SCORM RTE. Data defined in a content package manifest impact some initial values for some of the SCORM Run-Time Environment Data Model elements. Data from the manifest is used in the process of delivering and launching content to the learner and impacts the run-time environment. These and other relationships are described throughout the SCORM CAM book.

1.6.1.4. The SCORM Sequencing and Navigation (SN) Book

The SCORM SN book describes how SCORM-conformant content may be sequenced through a set of learner-initiated or system-initiated navigation events. The branching and flow of that content may be described by a predefined set of activities, typically defined at design time. The SCORM SN book also describes how a SCORM-conformant LMS interprets the sequencing rules expressed by a content developer along with the set of learner-initiated or system-initiated navigation events and their effects on the run-time environment.

The SCORM SN defines a method for representing the intended behavior of an authored learning experience such that any conformant LMS will sequence discrete learning activities in a consistent way.

The SCORM SN Model the required behaviors and functionality that SCORM conforming LMSs must implement to process sequencing information at run-time. More specifically, it describes the branching and flow of learning activities in terms of an Activity Tree, based on the results of a learner's interactions with content objects and an authored sequencing strategy. An Activity Tree is a conceptual structure of learning activities managed by the LMS for each learner as shown Figure 1.6.1.4a. In SCORM, a learning activity may references content objects that are delivered to the learner.

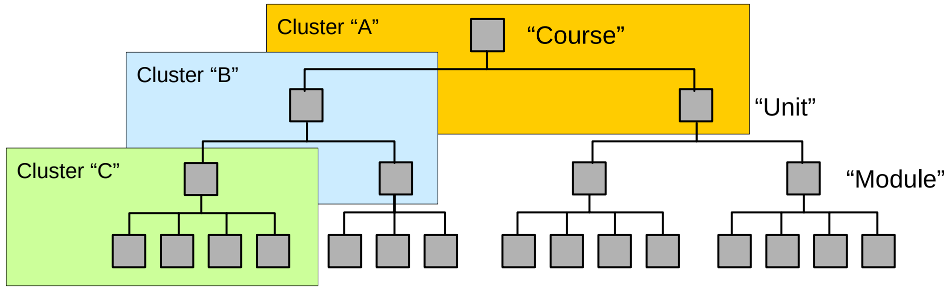

Figure 1.6.1.4a: Conceptual Activity Tree and Clusters

The SCORM SN book describes how learner-initiated and system-initiated navigation events can be triggered and processed, resulting in the identification of learning activities for delivery. Each learning activity identified for delivery will have an associated content object. The SCORM RTE book describes how identified content objects are launched. The sequence of launched content objects for a given learner and content structure provides a learning experience (learner interaction with content objects). The SCORM RTE model also describes how the LMS manages the resulting learning experience and how that learning experience may affect the Activity Tree.

Various concepts described in the SCORM CAM book have relationships to the SCORM SN book. The CAM describes how to build sequencing rules and represent those rules in XML. The CAM then describes how to build onto the existing manifest to apply these sequencing rules. See the SCORM SN book for more details on the relationship between the XML binding of the sequencing rules and the processes and behaviors of those rules.

1.6.2. Future Scope of SCORM

Discussions are underway within many standards organizations regarding "next generation" Web-based learning architectures. These discussions are expected to result in implementable specifications.

Listed below are examples of new capabilities that are candidates for topics to be included as SCORM evolves:

- Designing new run-time and content data model architectures
- Incorporating simulation aspects
- Incorporating electronic performance support objects
- Implementing SCORM-based intelligent tutoring capabilities
- Designing a new content model
- Incorporating gaming technologies

The exact scope and timetable for future versions of SCORM are not yet defined. These topics will be discussed and debated over the next year or more. Visit ADLNet.org for information about ongoing developments.

1.7. SCORM Conformance Testing and ADL Certification

ADL has developed the SCORM Conformance Test Suite, which contains the conformance testing software, procedures and supporting documents for organizations to perform self-testing on LMSs, SCOs, Meta-data XML documents and Content Packages. The SCORM Conformance Test Suite is available for download free of charge from ADLNet.org [5].

The ADL Certification program is a third-party testing of LMSs and content by a DoD-designated ADL Certification Testing Center. The ADL Certification Testing Centers use the latest SCORM Conformance Test Suite software as the primary basis of certification. Additionally, the ADL Certification Testing Centers may also impose added requirements for certification.

The Alexandria ADL Co-Laboratory signed a Memorandum of Understanding (MOU) in November 2002 with the Wisconsin Testing Organization in Madison, Wisconsin and the Naval Undersea Warfare Center (NUWC) Division Keyport in Keyport, Washington to designate these organizations as ADL Certification Testing Centers.

ADL Certification is independent testing that provides consumers of distributed learning products and content with the assurance that certified products have successfully implemented the SCORM. Certification is not an endorsement from the ADL Initiative or a guarantee that the product and/or content has been tested for defects in functionality and/or the product's content is instructionally sound.

Visit ADLNet.org for more details on SCORM Conformance Testing and ADL Certification.

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1.8. Commonly Used Terms in SCORM

Below is a list of commonly used terms throughout the SCORM books and their definitions.

ADL Co-Laboratory (ADL Co-Lab) Network – A network of facilities and resources to foster the collaborative research, development and assessment of the common tools, standards, content and guidelines for the ADL Initiative.

SCORM Run-Time Environment (RTE) Application Program Interface (API) - The communication mechanism for informing the LMS of the state of a content object (e.g., initialized, finished or in an error condition), and is used for getting and setting data (e.g., score, time limits, etc.) between the LMS and the Sharable Content Object (SCO).

Assets - Learning content in its most basic form is composed of Assets that are electronic representations of media, text, images, sound, web pages, assessment objects or other pieces of data that can be delivered to a Web client.

Content Organization – A map that represents the intended use of the content through structured units of instruction.

Content Model - Nomenclature defining the content components of a learning experience.

Content Packaging - Provides a standardized way to exchange digital learning resources between different systems or tools. Content Packaging also can define the structure (or content organization) and the intended behavior of a collection of learning resources.

SCORM Run-Time Environment (RTE) Data Model - A standard set of data elements used to define the information being communicated, such as, the status of the learning resource. In its simplest form, the data model defines elements that both the LMS and SCO are expected to "know about." The LMS must maintain the state of required data elements across sessions, and the learning content must utilize only these predefined data elements if reuse across multiple systems is to occur.

Learning Management System (LMS) - A suite of functionalities designed to deliver, track, report on and manage learning content, student progress and student interactions. The term "LMS" can apply to very simple course management systems, or highly complex enterprise-wide distributed environments.

Meta-data - Provides a common nomenclature enabling learning resources to be described in a common way. Meta-data can be collected in catalogs, as well as directly packaged with the learning resource it describes. Learning resources that are described with meta-data can be systematically searched for and retrieved for use and reuse. There are three types of meta-data:

Asset Meta-data - A definition of meta-data that can be applied to "raw media" Assets that provides descriptive information about the Asset independent of any usage or potential usage within courseware content. This meta-data is used to facilitate reuse and discoverability, principally during content creation, of such Assets within, for example, a content repository.

Content Organization Meta-data - A definition for meta-data that describes the content organization. The purpose of applying Content Organization Meta-data is to make the content organization accessible (enabling discoverability) within, for example, a content repository and to provide descriptive information about the content organization.

Sharable Content Object (SCO) Meta-data - A definition of meta-data that can be applied to SCOs that provides descriptive information about the content represented in the SCO. This meta-data is used to facilitate reuse and discoverability of such content within, for example, a content repository.

Sharable Content Object (SCO) - Represents a collection of one or more Assets that include a specific launchable asset that utilizes the SCORM Run-Time Environment to communicate with Learning Management Systems (LMSs). A SCO represents the lowest level of granularity of learning resources that can be tracked by an LMS using the SCORM Run-Time Environment.

The Sharable Content Object Reference Model (SCORM®) - Defines a Web-based learning "Content Aggregation Model" and "Run-time Environment" for learning objects. At its simplest, it is a model that references a set of interrelated technical specifications and guidelines designed to meet the DoD's high-level requirements for e-learning content.

SCORM Content Aggregation Model (CAM) - Provides a common means for composing learning content from discoverable, reusable, sharable and interoperable sources.

SCORM Run-Time Environment (RTE) - Provides a means for interoperability between Sharable Content Object-based learning content and Learning Management Systems.

SCORM Sequencing and Navigation (SN) - Rules that an LMS must follow in order to present a specific learning experience. The content developer is responsible for defining the rules to which an LMS must adhere. These rules are expressed within Content Structure and encoded in the *organization* section of Content Packaging. Through this means, the intended behavior of a collection of learning resources may be moved with a package from one LMS environment to another.

APPENDIX A
Acronym Listing

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Acronym Listing

ADL	Advanced Distributed Learning
AICC	Aviation Industry CBT Committee
API	Application Program Interface
ARIADNE	Alliance of Remote Instructional Authoring & Distribution Networks for Europe
CAM	Content Aggregation Model
CBI	Computer-Based Instruction
CMI	Computer Managed Instruction
DND	Department of National Defence
DoD	Department of Defense
DOL	Department of Labor
DTEP	Director of Training and Education Policy
IDA	Institute for Defense Analyses
IEEE	Institute of Electrical and Electronics Engineers
IMS	IMS Global Learning Consortium, Inc.
ITS	Intelligent Tutoring Systems
LMS	Learning Management System
LOM	Learning Objects Metadata
LTSC	Learning Technology Standards Committee
NGB	National Guard Bureau
NUWC	Naval Undersea Warfare Center
OSTP	Office of Science and Technology Policy
PIF	Package Interchange File
RTE	Run-Time Environment
SCO	Sharable Content Object
SCORM	Sharable Content Object Reference Model
SN	Sequencing and Navigation
SS	Simple Sequencing
UK	United Kingdom
UI	User Interface
XML	Extensible Markup Language

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APPENDIX B
References

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APPENDIX C
Document Revision History

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Document Revision History

SCORM Version	Release Date	Description of Change
1.3 Working Draft 1	22-Oct-03	Initial draft. Changes include: • Updates to SCORM Content Packaging to include changes introduced by the IMS Content Packaging Specification Version 1.1.3 • Updates to the SCORM Meta-data to include changes introduced by the standardization of IEEE 1484.12.1-2002 and IEEE 1484.12.3 Draft Standard for Extensible Markup Language (XML) Binding for Learning Object Metadata Data Model • Updates to include IMS Simple Sequencing Version 1.0 support. • Inclusion of support for Navigation requirements due to inclusion of IMS Simple Sequencing Version 1.0.
SCORM 2004 Overview	30-Jan-2004	Changes made: • Restructuring of document • Updates to reflect SCORM 2004