e-LEARNING INTEROPERABILITY STANDARDS

Interoperability among e-learning content and system components is a key to the successful implementation of an e-learning environment. There are several e-learning interoperability specifications and standards at various stages of development and adoption that are being promoted by a number of organizations and consortiums.

The purpose of this white paper is to provide a basic, non-technical understanding of these evolving e-learning standards, what the standards are intended to achieve, and the key players involved in developing the standards. Sun Microsystems™ is an ardent supporter of open standards in general and is actively supporting several e-learning standards initiatives.

This white paper refers to many concepts explained in more detail in another Sun Microsystems white paper titled "e-Learning Application Infrastructure". We recommend you read that white paper prior to reading this one.

THE VALUE OF e-LEARNING STANDARDS

The industrial and information ages run on standards: standards that allow screws to fit bolts and data to be transmitted and received. But standards look a lot different *after* they have been created, accepted, and adopted than when vendors are still negotiating over which standard is best and a long list of proposals are competing for consideration. e-Learning is in transition from the lawless "before standards" state to a more stable "with standards" state where the content and capabilities of product vendors can compete on a more stable basis.

Until very recently, the creation and implementation of learning technology has been left up to small communities of practice, rarely larger than a school district, university, or company training department and sometimes much smaller. Now, however, economies of scale and the existence of worldwide communication networks are driving learning technology toward globally scalable solutions. Such solutions cannot exist without standards anymore than the Internet can exist without standards such as TCP, IP, HTTP, and HTML.

Once e-learning standards are well defined and widely adopted, they will help the market achieve some key goals:

- From a consumer perspective, standards prevent lock-in to particular vendors and products. Costs are lowered as custom installations are replaced by "plug and play" set-ups. Furthermore, a larger market for learning content makes it more likely that content producers will invest the resources needed to produce a wide range of content, even in specialized areas.

- From a tools vendor perspective, standardized methods of interoperability eliminate the need to write proprietary interfaces to many different products. This results in lower development costs and increases the size of the potential market. Product vendors can compete on quality and value rather than the form of their solutions.

- From a learning content producer's perspective, standards allow content to be produced in a single format for use by any delivery system.

- From a learner's perspective, standards can lead to more choice of products and also make the results of their learning (for example, credit or certification) more portable, thereby supporting the "life long learner."

- From a designer's perspective, e-learning standards will make their jobs easier by giving them access to large storehouses of reusable content, by reducing the need to develop to multiple systems, and by allowing them to create modular content that can be more easily updated and maintained.

- From a Wall Street analyst's perspective, standards are the catalyst that signals the rapid growth phase in any industry.

This white paper is about the emerging standards that can help accomplish these goals. e-Learning standards are still in the emergent phase, and it can be difficult to sort out who is doing what and why. This white paper provides a fairly comprehensive list of initiatives in a reference table at the end of the document. However, the primary focus of this paper is to provide a general structure for thinking about e-learning interoperability standards, and to identify the more important standards and briefly explain what they do.

TYPES OF e-LEARNING INTEROPERABILITY STANDARDS

Figure 1 below provides a functional model of the different components of an e-learning application environment, and the objects and information that are shared among these components.

Prior to continuing, we recommend that you read the related Sun Microsystems white paper titled "e-Learning Application Infrastructure[i]", where this functional model is explained in detail.
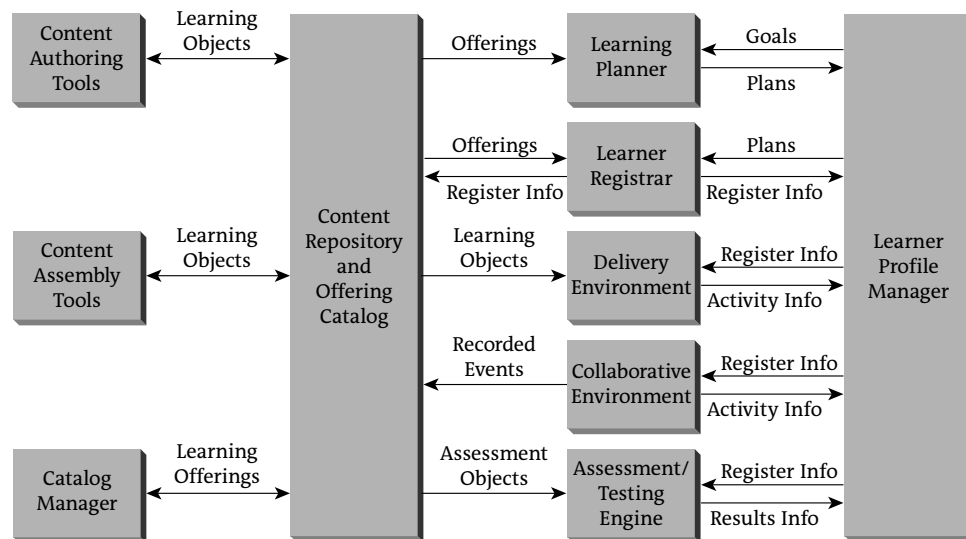

Figure 1: e-Learning Functional Model

(Source: Eduworks Corporation January 2002—www.eduworks.com)

The components of this environment are typically supported by multiple products from a number of vendors and need not be constrained by enterprise boundaries. Even medium-size enterprises may use different e-learning suppliers in different departments and extend their e-learning environment to their supply chain. If all the points of interoperability among e-learning components are supported by interfaces that vary from vendor to vendor, then it is very difficult and costly to implement an integrated learning environment.

In general, the purpose of e-learning interoperability standards is to provide standardized data structures and communications protocols for e-learning objects and cross-system workflows. When these standards are incorporated into vendor products, users of e-learning can purchase content and system components from multiple vendors, based on their quality and appropriateness, with confidence that they will work together effectively.

Using the model above, e-learning interoperability standards can be organized into some general categories:

Metadata

Content sits at the heart of e-learning. Learning content and catalog offerings must be labeled in a consistent way to support the indexing, storage, discovery (search), and retrieval of learning objects by multiple tools across multiple repositories. Data used for this purpose is referred to as *learning object metadata*.

Several initiatives are creating metadata standards:

- The IEEE Learning Technology Standards committee is nearing accreditation of a standard called Learning Object Metadata, or LOM.
- The IMS Global Learning Consortium, the Advanced Distributed Learning initiative, the Alliance of Remote Instructional and Distribution Networks for Europe, and many other organizations have adopted and adapted LOM.
- The Dublin Core Metadata Initiative has a different metadata standard (used by libraries, publishers, government agencies, and other organizations) that also has an educational version. They are working closely with the IEEE to create a kind of umbrella for both standards so that each can be viewed as a special case of a common framework.
- Educational Modeling Languages are emerging that describe the entire pedagogical methodology of a course. The IMS Learning Design team is trying to bridge the gap between high level and machine interpretable descriptions. All of this is in its nascent stages from a product perspective, but it may also be viewed as a form of metadata.

Content Packaging

Content packaging specifications and standards allow courses to be transported from one learning system to another. This is crucial since learning content can potentially be created by one tool, modified by another tool, stored in a repository maintained by one vendor, and used in a delivery environment produced by a different vendor. Content packages include both learning objects and information about how they are to be put together to form larger learning units. They can also specify the rules for delivering content to a learner.

The initiatives dealing with content packaging include:
- The IMS Content Packaging specification (commercialized as LRN by Microsoft and supported by multiple vendors),
- The IMS Simple Sequencing specification (under development),
- Aviation Industry CBT Committee guidelines and recommendations for computer managed instruction (specifically their notion of a *course structure file*),
- The Advanced Distributed Learning initiative (ADL) Sharable Content Object Reference Model (SCORM), based in part on Aviation Industry work, and
- The IEEE Learning Technology Standards Committee, currently putting the Aviation Industry and SCORM work through the accreditation process.

Assessments and their component questions are a special kind of learning content currently supported by a different set of specifications. The end effect is the same: Questions, tests, and test banks may be created in one environment and used in a different one. The initiative most relevant to assessment packaging is:
- The IMS Question and Test Interoperability specification (QTI).

Learner Profile

In the educational market, a learner is typically referred to as a "student", but this white paper uses the more general term "learner". Learner profile standards allow different system components to share information about learners across multiple system components. Learner profile information can include personal data, learning plans, learning history, accessibility requirements, certifications and degrees, assessments of knowledge (skills/competencies), and the status of participation in current learning.

Within the e-learning standards community the most important efforts to standardize learner profile information are:
- The IMS Learner Information Package (LIP) specification,
- The Personal and Private Information (PAPI) specification that was originally an IEEE draft and is now being looked at by ISO.

In addition to the above two efforts, it could be argued that vCard, transcript exchange standards such as SPEEDE/Express, parts of the Schools Interoperability Framework (SIF), and parts of Human Resource staffing protocols such as those from HR-XML are essentially learner profile specifications.

Learner Registration

Learner registration information allows learning delivery and administration components to know what offerings should be made available to a learner, and provides information about learning participants to the delivery environment.

There are two initiatives currently dealing with these requirements in e-learning:

- The IMS Enterprise working group has created a specification for exchanging offering and enrollment data among learning systems, and
- The Schools Interoperability Framework supports the exchange of this type of data in the K-12 environment.

Content Communication

When content is launched, there is the need to communicate learner data and previous activity information to the content. As a learner interacts with content, he generates some type of activity result, score or course grade. Course grades are often called *completion status* in the competency-driven corporate world. Sharing the launch, status of learning activities and results across multiple components of a learning environment requires standardization.

The standards being developed in this area allow components to share results at as low a level as an individual assessment question, or all the way up to a course grade or completion status. This is accomplished by creating standardized communication protocols and data models that allow learning content to communicate with the system that delivered it. Work is going on in two initiatives:

- The Aviation Industry CBT Committee. Their CMI (computer managed instruction) specification includes a communication component, and
- The Advanced Distributed Learning initiative's Sharable Content Object Reference Model (SCORM) project. SCORM 1.1 includes a JavaScript™ API for communication between a delivery system and the content it has delivered to a Web browser.

SUN™ SUPPORT FOR e-LEARNING STANDARDS

Technical Architecture

The types of standards listed above are being specified and implemented in several ways:

- Data models with XML and other bindings,
- Web-service architectures that rely on W3C protocols such as SOAP, WebDAV, and XQuery, and
- APIs with JavaScript and Java™ implementations. (Some older specifications create pseudo-API's using name-value pairs exchanged via HTTP posts.)

The capabilities, tools, and open architecture embodied in the Sun™ ONE infrastructure[ii] are well-suited for supporting an e-learning environment composed of tools and content from multiple vendors working together through e-learning interoperability standards. Sun platforms and technology allow the education community to pick and choose the best tools and content without being locked into any particular product or environment.

The Sun ONE architecture, and the iPlanet™ products that embody that architecture, are well-suited to supporting the demands of e-learning in education. This is embodied in the following characteristics:

Integratable: Supported by open standards and technologies to ensure operability across heterogeneous platforms, systems, and environments.

Evolutionary: Leverages your existing systems while affording services-on-demand flexibility.

Investment Protected: Designed to accommodate short and long-term software architecture needs.

Cost-Effective: Impacts your immediate business challenges now with proven, scalable products.

Integrated: Limits software integration costs by operating out-of-the-box with other Sun ONE products.

Enterprise-Ready: Supported by a network infrastructure company that understands mission-critical product and support needs.

Leadership in the Standards Community

As a company, Sun Microsystems is very active in the e-learning standards community. The objective of this involvement is to promote the timely development of open e-learning standards, and to ensure that Sun products and architectures effectively support clients' use of products built on these standards.

Some specific examples of this involvement, in bodies particularly relevant to the education market:

- On the advisory board of the Schools Interoperability Framework (www.siia.net/sif/about.html),
- Provided hardware to the Advanced Distributed Learning Initiative (www.adlnet.org),
- Active participant in work groups in the IMS Global Learning Consortium (www.imsglobal.org), and
- Founding member of JA-SIG, Java in Administration Special Interest Group (www.ja-sig.org).

STANDARDS DEVELOPMENT PROCESS

When evaluating vendors' claims of conformance to a particular e-learning standard, it is important to understand that many of these standards are still emerging, and lack clear methods for testing compliance. There are also good opportunities for vendors and consumer organizations to play important and active roles in the creation and validation of e-learning standards.

For these reasons, it is good to have at least a basic understanding of the standards development process and how various international organizations are working together. This white paper uses a conceptual standards development model developed by the leadership of a number of the e-learning standards organizations, depicted in Figure 2 below.
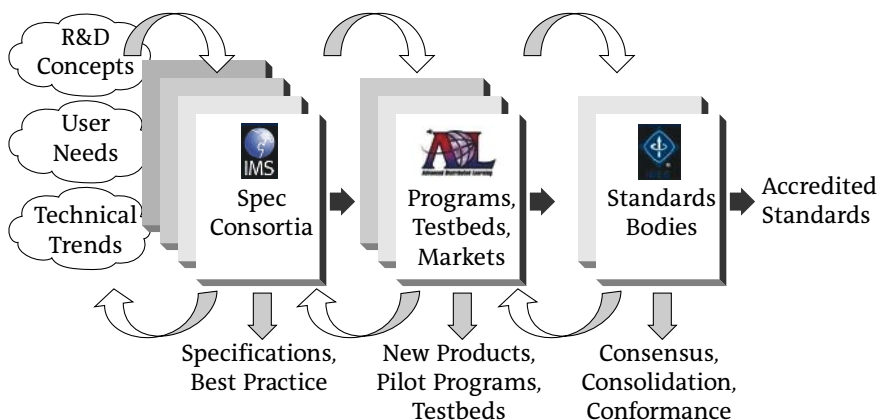

Figure 2: e-Learning Standards Process

(Source: Ed Walker, IMS Global Learning Consortium, 2001—www.imsglobal.org)

Specification

In this first step of the process, cooperating organizations work together to develop initial specifications that they hope to propose to the larger community as e-learning standards. These specifications are based on their analysis of the needs of the participating organizations.

Examples of consortia gathering requirements and developing specifications relevant to e-learning are:

- IMS Global Learning Consortium,
- CEN/ISSS Workshop on Learning Technology,
- Customized Learning Experiences Online (CLEO) which involves IBM, Microsoft, Cisco, NetG, and click2learn,
- Aviation Industry CBT Committee (AICC), and
- HR-XML Consortium.

Validation

In the next step, vendors develop new products that incorporate these specifications, pilot programs are initiated to test out the effectiveness and usability of the specifications, and testbeds are established for validating conformance to the specifications. Reference models are developed that show how different specifications and standards work together to support a complete e-learning environment.

Organizations creating testbeds and reference models for e-learning include:

- Advanced Distributed Learning initiative (ADL/SCORM),
- Advanced Learning Infrastructure Consortium (ALIC),
- Education Network Australia (EdNA), and
- European Commission Prometeus project.

Standardization

In the final step, specifications that have been proven and tested are taken to formal standards bodies for refinement, consolidation of competing efforts, clarification of conformance requirements, and accreditation.

It is important to clearly distinguish between a specification, which is an evolving work in progress, and an accredited standard, which is ideally based on actual implementations and experience, and provides very clear and unambiguous criteria for implementation and conformance.

Bodies creating accredited standards for e-learning are:

- IEEE Learning Technology Standards Committee, and
- ISO/IEC Joint Technology Committee Subcommittee on Standards for Learning, Education, and Technology.

Note: National standards bodies such as the British Standards Institute are also starting to produce accredited standards. These generally have less impact until brought to a pan-national level. CEN/ISSS *can* produce accredited standards with great regulatory weight in Europe, but their Workshop on Learning Technology intends to work through the IEEE and ISO/IEC, not through CEN/ISSS. In some Asian countries, efforts are underway to adopt e-learning standards as regulatory standards as well.

e-LEARNING STANDARDS ORGANIZATIONS AND INITIATIVES

This section focuses on the major organizations actively promoting the creation of e-learning specifications and standards, and describes the key initiatives they sponsor.

Of these organizations, those currently getting the most attention in the education market are:

- IMS Global Learning Consortium—www.imsglobal.org,
- Advanced Distributed Learning initiative (ADL) and their Sharable Content Object Reference Model (SCORM)—www.adlnet.org,
- Schools Interoperability Framework (SIF)—www.siia.net/sif/about.html, and
- IEEE Learning Technology Standards Committee (LTSC)—ltsc.ieee.org.

A larger list of organizations involved in various aspects of e-learning standards development is provided in a reference table at the end of this document.

IMS Global Learning Consortium

IMS (www.imsglobal.org) is an industry/academia consortium that develops specifications based on the needs identified by its supporting members. It was started in 1997 by the National Learning Infrastructure Initiative (NLII) (www.educause.edu/nlii) which is an organization sponsored by EduCause (www.educause.edu). IMS is now an independent, non-profit corporation owned by its participating members. IMS produces specifications and also offers workshops, developer support, and executive briefings. IMS is in the process of creating a *conformance and testing program* intended to be licensed by industry and national consortia and organizations. Membership is open. Fully participating members pay an annual fee that varies based on the size and type of organization, and there is also a lower-cost membership that does not provide voting or work group participation rights.

The nature and status of IMS's primary initiatives are described below:

Learning Object Metadata (LOM)

IMS Metadata specification is a primary source of input to the IEEE LOM standardization process, and has also been adopted by ADL as part of SCORM. IMS produced this specification in late 1999.

Content Packaging

The IMS Content Packaging specification creates standardized packages of learning objects, files referenced by the objects, and instructions for a learning management system to organize the learning objects in the package. This specification has been adopted by the ADL as part of SCORM and commercialized by Microsoft under the name LRN. IMS produced this specification in early 2000.

Question and Test Interoperability (QTI)

The IMS QTI specifies an XML format for encoding online questions, tests, and test banks. This enables the transport of such objects between learning systems. IMS produced this specification in mid 2000. Assessment engines are moving toward adoption of this specification, and it is likely to become part of SCORM in the future.

Learner Information Packaging (LIP)

The IMS Learner Information Package specification defines XML structures for the exchange of comprehensive learner information among cooperating systems. Some vendors and product development consortia have looked at adopting the LIP. This specification was produced in mid 2001.

Enterprise Interoperability

The IMS Enterprise specification defines XML packages for the exchange of class scheduling and learner registration information between systems. The first release, produced in early 2000, was primarily targeted at supporting the interaction between Learning & Course Management Systems and enterprise Student Administration and Human Resource systems. This specification has been implemented by a number of vendors of these systems.

The Enterprise specification is in the process of being revised to extend registration interoperability support to other types of learning systems, and to specify a messaging workflow architecture.

Simple Sequencing

The IMS Simple Sequencing working group is in the process of creating a specification that describes the way learning objects should be sequenced by a learning system.

Learning Design

The IMS Learning Design working group is looking at ways to describe and codify the learning methodologies embodied in a learning offering.

Digital Repositories

This IMS working group is in the process of creating specifications and recommendations for interoperation among digital repositories.

Competencies

The IMS (and IEEE) working groups are in the process of creating a standardized way of labeling the various components that go into defining "competencies" (also known as proficiencies, outcomes, etc.).

Accessibility

The IMS Accessibility working group is promoting accessible learning content through recommendations, guidelines, and modifications to other specifications. Accessible technology refers to technology that can be used without having full access to one or more input or output channels, usually visual, auditory, or motor.

Advanced Distributed Learning Initiative (ADL)

ADL (www.adlnet.org) is a joint White House/U.S. Department of Defense (DOD) initiative. The role of the ADL is to document, validate, promote, and sometimes fund the creation of specifications and standards from other sources. ADL sponsors "collaboratories" for the testing and implementation of specifications, and it disseminates specifications with implementation guidelines. Participation is open to all who can contribute.

Note: There are three collaboratories focusing respectively on the corporate, military, and academic sectors. The ADL enjoys broad international support despite its origin as a US project funded primarily by the DOD.

Sharable Content Object Reference Model (SCORM)

SCORM is the ADL's most widely known initiative. SCORM is a reference model for standardizing the reusability and interoperability of learning content. Version 1 focuses on two critical pieces of learning content interoperability:

1. It defines a model for packaging learning content.
2. It defines an API for enabling communications between learning content and the system that delivers it.

SCORM also divides the world of learning technology into functional components. The key components are: Learning Management Systems (LMS) and Sharable Content Objects (SCOs).

SCOs are a standardized form of reusable learning object. An LMS (for the purposes of SCORM) is any system that keeps learner information, can launch and communicate with learning objects, and can interpret instructions that tell it which object comes next. Additional components in the SCORM model are tools that create objects and assemble them into larger units of learning.
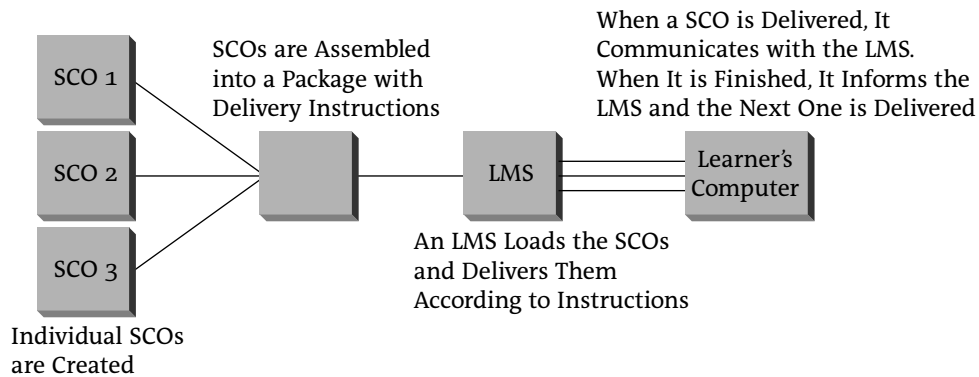
Figure 3: SCORM Model

(Source: Eduworks Corporation, 2002—www.eduworks.com)

Content Aggregation

SCOs are self-contained units of learning. They can be used as building blocks to create packages of objects, but they cannot be broken down into smaller units. Three things must be done to create a larger unit of learning from objects.

1. The objects must be found and organized into a structure.
2. Instructions must be written that tell an LMS which object comes after which.
3. The objects and instructions must be bundled into a portable package.

This process is called content aggregation. Note that content aggregation includes instructions for moving between objects but not for movement within individual objects. SCORM has adopted a content packaging format from the IMS Global Learning Consortium. A SCORM package contains a manifest file that declares the contents of the package and is set up to describe the order in which the objects are to be delivered. It also tells the LMS where to find the objects themselves. The physical resources represented by the object can be physically included in the package, or they can be referenced externally by the package.

Communicating with Content

The advantage of SCORM is that SCORM content can communicate learner information with *any* LMS using a standardized method based on JavaScript. The SCORM specification (which derives from work done by the Aviation Industry CBT Committee, or AICC) lays out exactly what pieces of learner information can be retrieved and updated. This information includes the learner's name, the learner's ID, scores on quizzes, time spent in a learning object, and the learner's physical device preferences. This is a simple implementation that covers the basic requirements for communicating learner information.

In the SCORM model, content initiates all communication. When it is launched, it tells the LMS it has started. When it wants something from the LMS, it asks for it. When it wants to update learner information, it tells the LMS. And when it is finished, it tells the LMS it is finished. This passes control back to the LMS, and the LMS decides which object will be delivered next.

Metadata

SCORM allows metadata to be included in every object and in every content package.

Schools Interoperability Framework (SIF)

The Schools Interoperability Framework (www.siia.net/sif/about.html) is an open specification for interoperability among K-12 instructional and administrative software applications. It was initiated by Microsoft, and was transferred to the Software and Information Industry Association once it got off the ground, as part of an effort to ensure an open architecture and broad industry acceptance. Membership is open to all organizations for an annual fee that varies depending on the size and type of organization.

Version 1.0 Revision 1 of the SIF specification was released in August 2001. The areas covered in this release are: architecture, messaging, data formats, security, object identifiers, and data models. The types of information targeted for exchange are student information, class registration, grade book data, food service records, financial records, library circulation, resource planning, transportation records, staff information, and school information. e-Learning interoperability is not the primary target of this specification, but the student, staff, registration, and grade book components overlap with several of the e-learning interoperability objects described above.

SIF is important for K-12 organizations and vendors. SIF is also beginning to work actively with IMS and other e-learning groups to identify overlapping areas and to work together where possible. This includes a focus on global requirements.

IEEE Learning Technology Standards Committee (LTSC)

The IEEE Learning Technology Standards Committee (ltsc.ieee.org) produces accredited open standards, reports, and guides as the result of *projects* authorized by the IEEE Standards Association. LTSC working groups develop draft documents corresponding to projects and, when ready, submit them to a consensus-driven balloting process overseen by the IEEE. Documents become standards after successful balloting and approval by the IEEE Standards Review Committee. The LTSC is open to all with a material interest. Members pay small annual dues. Email reflectors and documents are public.

Learning Object Metadata (LOM)

For learning objects to be used they must be found. It can be challenging to find *anything* in a large distributed online environment like the World Wide Web or a large intranet. The solution is to store not only learning objects but also *descriptions* of the learning objects. Thinking of the learning objects as *data*, the descriptions are *data about the data*, or *metadata*. Learning object metadata potentially includes information about the title, author, version number, creation date, technical requirements and educational context and intent. Metadata is used to support search, discovery, and retrieval of learning objects.

As of the writing of this white paper, the LOM standard was in the final stages of the formal IEEE balloting process. Check the LOM working group site for the latest status at ltsc.ieee.org/wg12/index.html.

Many organizations have been involved in moving the LOM to the point where it is being developed into an industry standard, but the bulk of the specification work was completed by the IMS consortium. Learning Object Metadata is compatible with the metadata used by the digital and online library community.

All e-learning tools that use, *develop*, or store content should be moving toward conformance with the LOM standard.

Other Initiatives

The LTSC working groups are also actively participating with other work groups from other organizations to develop standards in the areas of Content, Identifiers, Architectural Models, Vocabulary, and other topics. Some of these are entering the IEEE balloting process. The one with the broadest impact is in the area of Content. Some of the others are interesting but of less immediate value to vendors and their customers. The time line for formal accreditation is between nine months and two years. Some of the important IEEE initiatives will be discussed below in the context of other organizations' initiatives.

Aviation Industry CBT Committee (AICC)

The Aviation Industry CBT Committee (www.aicc.org) was formed in 1988 to standardize training products for the aviation industry. The AICC creates guidelines and recommendations (specifications) for use by its members and by vendors serving its members. The guidelines touch many areas of little outside interest (hardware, icons, peripheral devices), but they also define industry standards for *computer managed instruction (CMI)* that have been adopted by the entire e-learning industry and form the basis for SCORM. The AICC is apparently poised to re-adopt new versions of their own specifications and is working on specifications for simulations and so-called *smart graphics*. Although much of this work is spurred by high-end applications to

aviation and military training, it should apply equally well to learning environments based on multimedia games and virtual laboratories.

In addition to creating specifications, the AICC has instituted the only functioning *certification program* for e-learning standards. For a $5,000 fee the AICC will test and potentially certify that e-learning products conform to their CMI specifications. The idea is that certified content, for example, should run flawlessly on a certified Learning Management System. Unfortunately, this is not always the case in practice, but the "interoperability delta" between AICC certified components is likely to be small compared to that between non-certified components.

Other Global Initiatives

Some of the more important global initiatives with a strong focus outside of North America are:

CEN/ISSS Workshop on Learning Technology (WSLT)

CEN (Comité Europeén de Normalisation) creates accredited standards for Europe. ISSS (Information Society Standardization System) provides industry with standardization services that promote a European information society. Together they are sponsoring the Workshop on Learning Technology (www.cenorm.be/isss/Workshop/lt/). Membership is by invitation.

The WSLT is working on:

- Internationalization of the Learning Object Metadata,
- Standardized educational copyright,
- Quality assurance process standards (similar to ISO 9000),
- Educational modeling language (EML), and
- A repository of taxonomies (standardized codes) for European learning.

ISO/IEC JTC1 SC36

SC36 is a subcommittee of the International Standards Organization (ISO) and International Electro-technical Committee (IEC) Joint Technical Committee on Information Technology (jtc1sc36.org/). It produces accredited open standards for learning, education, and training. Representation to SC36 is by national bodies. The CEN/ISSS Workshop on Learning Technology and the IEEE Learning Technology Standards Committee have liaisons with SC36 that permit active contributions. Many, although certainly not all, of the current SC36 projects have their roots in IEEE LTSC standardization efforts.

Advanced Learning Infrastructure Consortium (ALIC)

ALIC (www.alic.gr.jp/eng/index.htm) is a Japanese coalition of private and public organizations promoting the adoption of e-learning in Japan.

Alliance of Remote Instructional and Distribution Networks for Europe (ARIADNE)

A European Foundation with members from industry and academia that has created specifications and technology for online learning (www.ariadne-eu.org).

Education Network Australia (EdNA)

EdNA (www.edna.edu.au) is a collaborative framework involving all Australian education and training authorities focused on maximizing the benefits of the Internet to their stakeholders. EdNA Online is the 'gateway' or 'portal' to information and curriculum resources. EdNA disseminates and participates in the creation of a range of technical standards. EdNA's guiding committee is AICTEC—the Australian ICT in Education Committee www.aictec.edu.au.

PROmoting Multimedia access to Education and Training in EUropean Society (PROMETEUS)

PROMETEUS (www.prometeus.org) is an open initiative launched in March 1999 under the sponsorship of the European Commission with the aim of building a common approach to the production and provision of e-learning technologies and content in Europe. It operates via a Memorandum of Understanding signed by all members and sponsor SIG's and expert communities.

FUTURE DIRECTIONS IN STANDARDS

The following themes should guide much of the work in e-learning standards bodies over the coming year.

Expansion of Content Specifications and Reference Models

e-Learning standards organizations are focusing heavily on learning content standards. The ultimate goal is a learning object economy characterized by searchable stores of reusable learning objects that can be assembled into adaptive units of learning and delivered by any learning system. However, the problems facing the e-learning industry right now are basic questions of learning content interoperability.

Content Repositories

Having objects is not enough. One must also be able to store them, find them, and retrieve them. In 2002 the standards community should select much of the infrastructure that will be used to build, connect, and enable searching across multiple digital learning object repositories.

Internationalization and Localization

Standards groups are active all over the globe and are increasingly eager to cooperate. This brings two challenges: that of creating culturally neutral standards (inter-

nationalization) and that of adapting standards to local needs (localization). Internationalization is addressed in part by ISO technical standards which need to be followed more closely by the e-learning community. Vendors should plan to incorporate appropriate language and encoding standards. Cultural neutrality in standards that address metadata and instructional design is much trickier. Standards bodies are grappling with these issues and vendors can glean valuable information by participating in these deliberations.

Conformance and Compliance Testing

A major complaint about e-learning standards is that products claiming conformance do not work together without further tweaking. This translates into lost time and expensive service engagements. As a result of this challenge, there is an increasing emphasis on developing conformance tests and certification programs. Expect to see certification programs for IMS, SCORM, IEEE, and other specifications and standards emerge in the coming year.

Architecture

e-Learning has grown organically without a clear picture of the components of a typical e-learning system or how they interrelate. The need for such an architecture is critical for defining competitive arenas and for standards development. Expect standards bodies to make progress toward an overall architecture in 2002.

REFERENCES

e-Learning Standards Organizations

This section features a chart of organizations, consortia, and standards bodies that play significant roles in the e-learning standardization cycle. A few are included as general references. Each organization is given a *type* and a *role*. The role refers to its role in the standardization cycle. The type is the type of organization and often refers to whether the organization is *open* or *closed*. In the standards world, *open* means publicly available and developed by a process that is vendor neutral. *Closed* organizations serve the interests of a small group of vendors or institutions. Open should not be confused with the lack of a membership fee or membership criteria—most open specification or standards producing organizations have both.

This chart is intended to be a fairly comprehensive list of standards bodies affecting e-learning, and is included here as a general reference tool. The body of this white paper contains a section that highlights the work of the organizations most directly involved in generating key e-learning standards. It also provides a list of those most important to the education market.

ACRONYM	NAME/URL	TYPE	ROLE	DESCRIPTION
ADL	Advanced Distributed Learning initiative www.adlnet.org/	U.S. Federal initiative with participation open to all who can contribute.	Documents, validates, promotes, and some-times funds the creation of specifications and standards from other sources.	Joint White House—Department of Defense (DOD) initiative. Sponsors "collaboratories" for testing and implementation, and disseminates specifications with implementation guidelines.
AICC	Aviation Industry CBT Committee www.aicc.org/	Industry consortium. Offers membership to all interested organizations.	Produces specifications. Has implemented a certification program. Has turned its Web-based *e-learning* work over to the ADL and IEEE LTSC.	An industry consortium that has produced many important "guide-lines and recommendations" (i.e., specifications) for computer-based training.
ALIC	Advanced Learning Infrastructure Consortium www.alic.gr.jp/eng/index.htm	Open consortium that includes academic, corporate, and individual members.	ALIC primarily validates and documents specifica-tions from other sources although it is producing some of its own. Part of its mission is promo-tional.	A Japanese coalition of private and public organizations promoting the adoption of e-learning in Japan.
ANSI	American National Standards Institute www.ansi.org/	Non-profit organiza-tion with open corpo-rate, educational, agency, and individual memberships.	Produces accredited standards and accredits standards organizations.	ANSI is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. It is recog-nized by ISO as the U.S. national standards body. ANSI accredits numerous other standards bodies, including the IEEE. The ANSI reference library is an excellent resource. For a list of international accredited standards organiza-tions, see www.ansi.org/public/library/internet/intl_reg.html.
ARIADNE	Alliance of Remote Instructional and Distribution Networks for Europe www.ariadne-eu.org	Foundation. Membership is open to all interested parties.	Produces specifications and tools/services based on those specifications.	A European Foundation with members from industry and academia that has created specifi-cations and technology for online learning.
CEN/ISSS WS-LT	Comité Européen de Normalisation/Information Society Standardization System Workshop—Learning Technology www.cenorm.be/isss/Workshop/lt	CEN is an accredited standards body, but its workshops function as open groups that invite expert participation and do not produce accredited standards.	Validates, modifies, and disseminates specifica-tions for the European space.	CEN/ISSS Workshops are funded by the European Commission and are centered around a series of deliverables. The Learning Technologies work programs include internationalization and translation of IEEE Learning Object Metadata, a report on the feasibil-ity of educational copyright licenses, quality standards for learning technology, a repository of taxonomies, and a bulletin on standards activities.

ACRONYM	NAME/URL	TYPE	ROLE	DESCRIPTION
CLEO	Customized Learning Experiences Online www.cleolab.org	Closed consortium.	Gathers requirements. Makes suggestions for early specifications.	CLEO operates under the IEEE Industry Standards and Technology Organization. CLEO participants are IBM Mindspan Solutions, Cisco Systems, Microsoft Corporation, click2learn, and NetG with academic support from the UK Open University, and the Carnegie Mellon Learning Systems Architecture Lab. CLEO's goals are to conduct focused, applied research on technical and pedagogical issues related to the ADL Sharable Content Reference Model (SCORM).
DCMI	Dublin Core Metadata Initiative www.dublincore.org	Open consortium.	Produces and disseminates specifications.	An open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models.
EdNA	Education Network Australia www.edna.edu.au	Australian initiative funded and jointly managed by all Australian ministries of education.	Validates, documents, and disseminates specifications and standards as a free service to Australian educators.	Australian gateway to resources and services for education and training. EdNA disseminates and participates in the creation of an extensive set of technical standards.
EICA	Energy Industry CBT Consortium www.eicaonline.com	Closed consortium.	Intends to act as an e-learning consumer and participant in standardization efforts.	The EICA is a (new) international association of large energy companies that use technology-based training. The EICA provides an organizational structure for IT, HR, Training, EH&S, and other professionals to collaborate on shared technology-based training objectives. The EICA mission is to establish the energy industry as one of the leading industries influencing the future of technology-based training, and to more effectively manage the growth of technology-based training within the energy industry.
e-Learning Consortium	Masie e-Learning Consortium www.masie.com/masie/default.cfm?page=consortium	Open consortium with a limited number of available memberships.	Not really part of the standardization cycle, but can serve as a promotional and dissemination arena.	The e-Learning Consortium is sponsored by the Masie Center and is a collaboration of major corporations, government agencies, and e-learning providers focused on the future of e-learning. The consortium is intended to be a community of practice which provides an informational network and self-generated data on *e-learning* practices and technology.

ACRONYM	NAME/URL	TYPE	ROLE	DESCRIPTION
HR-XML	HR-XML Consortium www.hr-xml.org	Open consortium.	The HR-XML consortium produces specifications with the intention of producing industry standards.	The HR-XML consortium is an independent, non-profit organization dedicated to the development and promotion of standardized XML vocabularies for human resources. Among the schemas being produced are schemas for cross-process objects, competencies, recruiting and staffing, and staffing industry data exchange standards, all of which could be relevant to *e-learning* systems.
IEEE LTSC	Institute for Electronic and Electrical Engineers Learning Technology Standards Committee ltsc.ieee.org	Accredited standards body.	Produces accredited standards.	Accredited standards body dealing with learning technology standards.
IETF	Internet Engineering Task Force www.ietf.org	Open organization.	Produces specifications and standards.	IETF is an open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. IETF produces specifications (known as "requests for comments" or RFCs), guidelines, and standards.
IMS	IMS Global Learning Consortium www.imsglobal.org	Open consortium.	Produces specifications; offers workshops, developer support, and executive briefings; and is creating a conformance and testing program intended to be licensed by industry and national consortia and organizations.	An industry/academia consortium that develops specifications. Started by the National Learning Infrastructure Initiative (in turn sponsored by EduCom, now EduCause) in 1997.
ISO	International Standards Organization www.iso.ch/iso/en/ ISOOnline.frontpage	Membership in ISO is restricted to national bodies. A member body of ISO is defined as the national body "most representative of standardization in its country.	ISO produces accredited open standards.	ISO creates international standards through an open process based on industry-wide consensus. ISO standards become legal mandates in many countries.

ACRONYM	NAME/URL	TYPE	ROLE	DESCRIPTION
ISO/IEC JTC1 SC36	International Standards Organization/ International Electrotechnical Committee Joint Technical Committee 1 (Information Technology Standards), Subcommittee 36: Standards for Learning, Education, and Training jtc1sc36.org	Membership is open to national bodies. SC36 has liaisons with other relevant standards bodies.	SC36 produces accredited standards.	SC36 is an international standards body creating accredited open standards. Representation to SC36 is by national bodies. The CEN/ISSS Workshop on Learning Technology and the IEEE Learning Technology Standards Committee have liaisons with SC36 that permit active contributions. Many, although certainly not all, of the current SC36 projects have their roots in IEEE LTSC standardization efforts.
JA-SIG	Java in Administration Special Interest Group www.ja-sig.org	Open consortium.	JA-SIG plays a dissemination and networking role and is supporting the development of a free, open source, open standard portal for higher education.	JA-SIG is an independent organization designed to increase the flow of information between educational institutions and companies involved in the development of administrative applications using Java technology. Sun Microsystems was a founding member of JA-SIG.
OKI	Open Knowledge Initiative web.mit.edu/oki	Closed consortium of academic institutions. Membership is expanding.	OKI is creating both specifications and reference implementations.	OKI is creating a free open source course management system for higher education. In the process it is developing an architectural specification and specifications for a variety of relevant APIs in cooperation with the IMS Global Learning Consortium, ADL, JA-SIG, and others.
PROMETEUS	PROmoting Multimedia access to Education and Training in EUropean Society www.prometeus.org	Open consortium.	Comments on specifications and standards and offers networking support.	PROMETEUS is an open initiative launched in March 1999 under the sponsorship of the European Commission with the aim of building a common approach to the production and provision of e-learning technologies and content in Europe. It operates via a Memorandum of Understanding signed by all members and sponsor SIG's and expert communities. WARNING: SLOW MEDIA-RICH WEB SITE.
SIF	Schools Interoperability Framework www.siia.net/sif/ about.htm	Open consortium.	Producing a specification as an open industry standard.	A division of the Software & Information Industry Association creating an XML specification for managing and sharing data for K-12.

TABLE 1:

ACRONYM	NAME/URL	TYPE	ROLE	DESCRIPTION
W3C	World Wide Web Consortium www.w3.org	Open consortium.	W3C produces open specifications called "recommendations" and plays an important dissemination and testing role. It also produces reference implementations such as the AMAYA Web browser.	The W3C creates *the* specifications, guidelines, software, and tools for the World Wide Web. The W3C concentrates on general infrastructure such as HTTP, HTML, XML, RDF, SOAP, and Web Accessibility Guidelines. None of its work is specific to *e-learning*, although the only "application" it has ever produced is Mathematics Markup Language (MathML), which is of educational importance.
WebDAV	Web-based Distributed Authoring and Versioning www1.ics.uci.edu/pub/ietf/webdav/	Open working group.	Producing a specification.	WebDAV.org is developing DAV, a specification for collaborative work over the Web. It has submitted its work to IETF for open standardization.

Source: Eduworks Corporation, 2002[iii]

Glossary of e-LEARNING Standards Acronyms

ADL—Advanced Distributed Learning initiative

AICC—Aviation Industry CBT Committee

ALIC—Advanced Learning Infrastructure Consortium

ANSI—American National Standards Institute

ARIADNE—Alliance of Remote Instructional and Distribution Networks for Europe

CBT—Computer-Based Training

CDLSC—Chinese Distant Learning Standards Committee

CEN—European Committee for Standardization

CLEO—Customized Learning Experiences Online

CBT—Computer Based Training

CMI—Computer Managed Instruction

EdNA—Education Network Australia

IEEE—Institute of Electrical and Electronic Engineers

IEC—International Electrotechnical Commission

ILT—Instructor-Led Training

EML—Educational Modeling Language

HR-XML—Human Resource XML Consortium

IMS—IMS Global Learning Consortium

ISO—International Organization for Standards

ISSS—Information Society Standardization System

JTC1—Joint Technical Committee 1

LCMS—Learning Content Management System

LTSC—Learning Technology Standards Committee

LIP—Learner Information Package

LMS—Learning Management System

LOM—Learning Object Metadata

QTI—Question and Test Interoperability

SCORM—Shareable Content Object Reference Model

SIIA—Software and Information Industry Association

SIF—Schools Interoperability Framework

SOAP—Simple Object Access Protocol

WBT—Web-Based Training

WSLT—Workshop on Learning Technology

W3C—World Wide Web Consortium

XML—Extensible Markup Language

Other References

Barritt, Chuck—"Reusable Learning Object Strategy", version 4.0, Cisco Systems, November 2001
www.cisco.com/warp/public/10/wwtraining/e-learning/implement/rlo_strategy_v3-1.pdf

Curtain, Rob (Sallie Mae Solutions)—"The Death of Integrated Systems—
Why Interoperable Systems Will Define Your Future", Educause 2001 presentation

Dublin Core—dublincore.org

Eduworks—www.eduworks.com/standards

Fowler, John—"The Value of Open Standards in Higher Education Infrastructure"
Sun Microsystems white paper—
www.sun.com/edu/infrastructure/SunONEinEduF1a.pdf

Hodgins, Wayne and Conner, Marcia—"Everything you ever wanted to know about learning standards but were afraid to ask." Linezine, Fall 2000—
www.linezine.com/2.1/features/wheyewtkls.htm

Learnativity—www.learnativity.com

Learning Object Network—Technical Note "The Importance of e-Learning Standards"
www.learningobjectsnetwork.com/TheImportanceOfE-LearningStandards.pdf

Learning Object Network—www.learningobjectsnetwork.com

Rosenberg, Michael—"Quick tips for surviving the interoperability myth",
e-Learning Magazine, October 1, 2001

Sun Microsystems—Education and Research White Papers—
www.sun.com/products-n-solutions/edu/whitepapers/index.html

Footnotes

[i] Sun Microsystems white paper—"e-Learning Application Infrastructure",
January 2002
www.sun.com/products-n-solutions/edu/whitepapers/index.html

[ii] To read more about the Sun ONE architecture in the context of a Higher Education environment, see the white paper at
www.sun.com/edu/infrastructure/SunONEinEduF1a.pdf

[iii] Eduworks Corporation—"e-Learning Standards Organizations", from the www.eduworks.com/standards web site

About the Authors:

Geoff Collier and Robby Robson are Senior Partners of the Eduworks Corporation (www.eduworks.com), a consulting and solutions company specializing in e-learning standards and products. Eduworks tracks global e-learning standards efforts and provides clients with information and support related to the interpretation and use of these standards.

Sun microsystems
take it to the nth