I N D U S T R Y   R E P O R T

MASIE Center eLEARNING CONSORTIUM

Making Sense of Learning Specifications & Standards:

A Decision Maker's Guide to their Adoption

2nd Edition

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The MASIE Center
Learning and Technology e-Lab & ThinkTank

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Special Thanks

Dear Learning and Training Colleagues:

We are pleased to release the UPDATED version of the S3 Working Group Report to make Sense of Standards and Specifications (S3).

In 2000, with the goal of lowering industry confusion about learning standards and accelerating their adoption, The MASIE Center's e-Learning Consortium organized and facilitated a group of learning professionals who worked together for several months to generate a collection of information and job aids. The original report was released in February 2001 and was downloaded by over 25,000 organizations around the world. Over the past few months, the group has reconvened and contributed a great amount of work and passion to updating the document.

The concept of "learning standards" is at the same time one of the most powerful and most misunderstood aspects of the e-Learning revolution. As organizations make significant investments in digital learning content, there is a strong desire to have greater assurances of portability and re-usability. As organizations focus on providing learners with the "just right" content and activities, there is a strong desire to have the ability to more easily store, search, index, deploy, assemble and revise content. All of these hopes are part of the story of learning standards.

A small group of e-Learning CONSORTIUM members formed the S3 Working Group to make Sense of Standards and Specifications (S3). I want to thank the members of this group for their hard work and passion on this topic. Wayne Hodgins, from Autodesk, was the Visionary Leader of this group. This edition was compiled and edited by Maria Nissi.

In this spirit of the document, please spread this vital information by distributing it freely to your colleagues in its entirety. If you have any comments, questions or suggestions, please send them to standards@masie.com.

Yours in Learning,
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Vision Statement

The Vision: Getting it "Just Right"

To set some context for learning standards, it is important to note the over-arching vision that guides and propels them forward. We might even synthesize the vision into just one word: PERSONALIZATION. In learning, personalization means making learning dramatically more effective by being relevant and responsive to the uniqueness of every individual and their circumstances, every day.

Great progress has been made toward this lofty vision and we are currently making the transition from "anytime, anywhere" learning to the "right" learning, anytime and anywhere. Thanks to the great innovations and hard work of the past 20 years, we have successfully attained what was once imagined as impossible. We can reach almost any person, any time, anywhere, and we can transport almost anything digital between them. Reaching this state has not been easy, fast, or cheap, but it has been established as the base line in many places. While we still face a great amount of work to extend this capability to all locations and people, it is also now time to devote our attention to building upon this enormous success and attaining the goal of getting it "just right."

Think about it— you don't want just *any* resource, you want the ones which are *just right* for the situation at hand. You don't want any piece of code or content or any person— you want just the right ones. In this context, "right" is a relevant term: right for the specific situation, circumstances, limitations, and constraints.

Getting to "just right"

Attaining this goal means incorporating:

- just the right People
- with just the right Resources
- at just the right Time & Place
- in just the right Amount
- in just the right Context
- on just the right Device
- using just the right Medium.

If we continue to insist on having a prefix for "Learning," perhaps we can think about this as "me-Learning"? With this as context, let's look at the enabling role standards play if we are to realize this grand vision of personalized learning experiences for every person, everyday.

Why Standards?

History has shown rather conclusively that the takeoff point for any new era or innovation includes the adoption of common standards. Examples would include railway track gauge, telephone dial tones, video tape formats, email protocols, and the Internet and World Wide Web themselves. Similarly, we can see that without such common adoption of standards, the market stalls. Consider the historic battle between VHS and Beta that withheld the explosion of the video industry. Or, look to current examples such as the lack of common standards for DVD recorders or instant messaging. These stories often start out with proprietary specifications from an individual company or source. Unfortunately, this often means that emerging technologies are built using proprietary specification and will not work well with other similar or competing products. Since these technologies often do not meet the needs of end-users, the market typically drives the various leaders from business, academia, and government to work together to develop common "standards." This allows a variety of products to co-exist. This convergence of technologies is very important for the consumers of these technologies. Products that adhere to standards will provide consumers with wider product choices and a better chance that the products in which they invest will avoid quick obsolescence.

In the world of learning, common standards for things such as content metadata, content packaging, content sequencing, question and test interoperability, learner profiles, and run-time interaction are requisite for the success of the knowledge economy and the future of learning. Breaking from the tradition of conflict as noted in some of the examples above, in the case of learning technology standards there has been a wonderful lack of competing standards. Even with this significant advantage, it has taken many years of extremely hard and thankless voluntary work by many individuals and groups from the world learning community. They have designed and developed these specifications and ratified them through standards bodies such as IEEE to create fully accredited standards.

As a result, and with a nod of thanks and appreciation to these efforts, robust accredited standards and specifications are now available and being implemented everyday around the globe in real world situations and with scalability. The attention therefore now shifts to the many issues and questions of how we will integrate these standards into our current projects and plans for the future.

Why should an organization care about the emergence and convergence of learning standards? Because every organization must protect and increase its return on investment from the learning technologies and services it purchases and learning content it develops. Organizations spend millions of dollars on technologies, content, and services to improve knowledge and skills. If the systems cannot grow, be sustained, maintained, and delivered to the learners, the investment will be wasted or seriously less effective on returning results.

To make this vision for "me-Learning" and sustained human performance improvement a reality, standards are critical enablers that help to ensure the six "-abilities": Interoperability, Re-usability, Manageability, Accessibility, Durability, Scalability, Affordability.

Document Objectives

The success of a standard is ultimately measured by the degree to which the standards are voluntarily adopted and adapted by people and organizations around the world. This status of “de facto” standardization is the ultimate goal. Until these standards reach this critical mass of use in business, government, and academia, the investment of time and resources in standards will be of limited value.

In 2001, in order to lower industry confusion about learning standards and to accelerate their adoption, the MASIE Center's e-Learning Consortium organized and facilitated a group of learning professionals who worked together for several months to create and publish the original “S3” industry report. It was descriptively titled: "Making Sense of Standards and Specifications: A Decision Makers Guide to their Adoption," or "S3" for short. It continues to be one of the most commonly downloaded files on The MASIE Center site and is accessed and referenced by groups from around the world.

However, much has changed since 2001 and standards are no exception. We now have some fully accredited standards such as those for Learning Object Metadata, Content Packaging, and others from the IEEE Learning Technology Standards Committee. The big change since 2001, though, is that the focus has shifted from deciding *if* standards should be used to determining *how* they will be implemented.

Given these changes and evidence that standards are playing an even greater and more critical role than many imagined, The MASIE Center e-Learning CONSORTIUM decided to reconvene the S3 Working Group and develop an updated version of their original report. The result will hopefully contribute to the goal of enabling more effective learning through a critical mass-adoption of standards.

Document Overview

Section 1: Primers
The first section of the document consist of seven primers that provide an overview of learning standards for those interested in learning how to apply them in their own organization:

- *What is e-Learning and the e-Learning Industry?*
- *Understanding the Standards Concept*
- *How Standards are Formed*
- *What is SCORM®?*
- *Using Standards in Your Organization*
- *Talking Standards with e-Learning Suppliers*
- *Trends*

Section 2: Understanding Conformance: Most Learning Management Systems (LMS) or content vendors today claim some sort of compliance or conformance to the latest learning standards. As a result, these terms are used freely, without a real understanding of their meaning and, to add to the confusion, are often used interchangeably. This section provides a clear and concise understanding of which term to use and why, as well as how "conformance" relates to a product's adherence to an individual specification or standard.

Section 3: Metadata -- Why Implement?: The term metadata is used frequently throughout the e-Learning world, but what does it mean? How does its value apply to your organization? This section defines metadata, provides examples, and explains its inherent value, detailed in examples of its four main uses in learning.

Section 4: Learning Objects -- Building Blocks for Learning: The emergence of learning technologies has significantly altered the way in which people acquire the knowledge and skills they need to do their jobs. One learning technology concept in particular, the Learning Object (LO), has the potential to revolutionize the paradigm of learning. This section explains the concept of Learning Objects, illustrates the hierarchy of a Learning Object, and explains Sharable Content Objects (SCOs) and how they fit into the hierarchy.

Appendix 1: Standards and Specifications Groups: This appendix identifies the various groups and organizations responsible for developing standards and provides links for further reference.

Appendix 2: Learning Standards Glossary: This appendix is a glossary of key terms used throughout the document in discussing e-Learning, standards, and their implementation.

Section 1: Primers

What is e-Learning and the e-Learning Industry?

A simple working definition of the term e-Learning is “learning or training that is prepared, delivered, or managed using a variety of learning technologies and which be deployed either locally or globally.” The promise of e-Learning is that it provides leadership with powerful new tools for improving capability, development, speed, and performance whether an organization operates in one geography or many. Just as the rise of information technologies fundamentally changed the nature of how work gets done in organizations, the emergence of learning technologies is fundamentally changing the nature of how people learn to do that work.

It is important to note that the fundamental learning model has not changed. Learning professionals still help others learn how to do things they could not do before. In non-academic settings, this means they remain focused on providing leadership with the ability to build organizational capacity and improve performance. Learning technologies are simply a sophisticated new tool that enables each learning professional to be more productive at helping others learn.

Understanding the Standards Concept

As we have seen historically with battles over such things as railway track gauge, telephone dial tones, video tape formats, email protocols, and the platform battles between Microsoft, Apple, Sun, IBM, and others, companies often start out with proprietary technology that will not work well with others. However, these technologies often do not meet the needs of end-users, and thus, the market typically drives the various leaders from business, academia, and government to work together to develop common “standards.” This allows a variety of products to co-exist. This convergence of technologies is very important for the consumers of these technologies because products that adhere to standards will provide consumers with wider product choices and a better chance that the products in which they invest will avoid quick obsolescence. Likewise, as mentioned previously, common standards for things such as content metadata, content packaging, content sequencing, question and test interoperability, learner profiles, run-time interaction, etc., must be in place and widely accepted for the knowledge economy and the future of learning to realize this vision. The first versions of these standards and specifications have now arrived. The question is this: How are we to integrate these standards into our plans for the future as well as into our current projects?

As mentioned in the Vision Statement, standards help to ensure the six "abilities” which protect and even nurture e-Learning investments. They are:

- Interoperability
    - mix and match content from multiple sources and within multiple systems
    - multiple systems communicate, exchange, and interact transparently

- Re-usability
    - content and code can be assembled, disassembled, and re-used quickly and easily
    - content objects can be assembled and used in a context other than that originally designed
- Manageability
    - systems can track the appropriate information about the learner and the content
    - management of the complex selection and assembly of "just the right" stuff
- Accessibility
    - a learner can access the appropriate content at the appropriate time on the appropriate device
- Durability
    - buyers are not "trapped" by a particular vendor's proprietary learning technology
    - no significant additional investment is required for re-usability and interoperability
- Scalability
    - learning technologies can be configured to have expanded functionality to serve broader populations and organizational purposes
    - an organization's return on investment in e-Learning products can increase if they can be leveraged beyond their original scope
- Affordability
    - ensure that our learning technology investments are wise and adverse to risk

How Standards Are Formed

In the learning world, long before the phrase "e-Learning" appeared, many organizations all around the world began working diligently to create specifications for learning-related technologies, and needs such as metadata, learner profiling, content sequencing, Web-based courseware, and computer-managed instruction. This early work was done by such groups as ARIADNE in Europe, the Dublin Core, IEEE, the Aviation Industry's CBT Committee AICC, and the EDUCAUSE IMS Consortium. At first, these groups focused on different areas of the standards, working simultaneously but not in coordination. The U.S. Department of Defense has taken a leadership role in bringing the work from all the disparate standards organizations together into a common and usable "Reference Model" now known as the "Sharable Content Object Reference Model," or SCORM. SCORM is a unified set of core specifications and standards for e-Learning content, technologies, and services. Today, these various specification and standards bodies are working together and collaborating on SCORM, both in its current and future forms. SCORM has proven that the existing specifications and standards are able to deliver on the promises of interoperability, re-usability, etc., and provide the foundation for how organizations will use learning technologies to build and operate in the learning environment of the future. Ongoing work in this area promises to convert even more of the potential into reality.

To understand standards, it's important to understand the following key terms that relate to the evolution of standards.

Specification:
Similar to the common use of the word, a *specification* is a detailed, exact statement of the functional requirements and particulars for something to be built, installed, or manufactured. Some specifications are further developed to the status of an accredited standard, which means they have received the stamp of accreditation after having proceeded through the four stages outlined below. In some industries, something cannot be sold until it receives a stamp of approval by conforming to a given standard (i.e., electrical devices are accredited by IEEE).

Standard:

There are two types of standards*:*

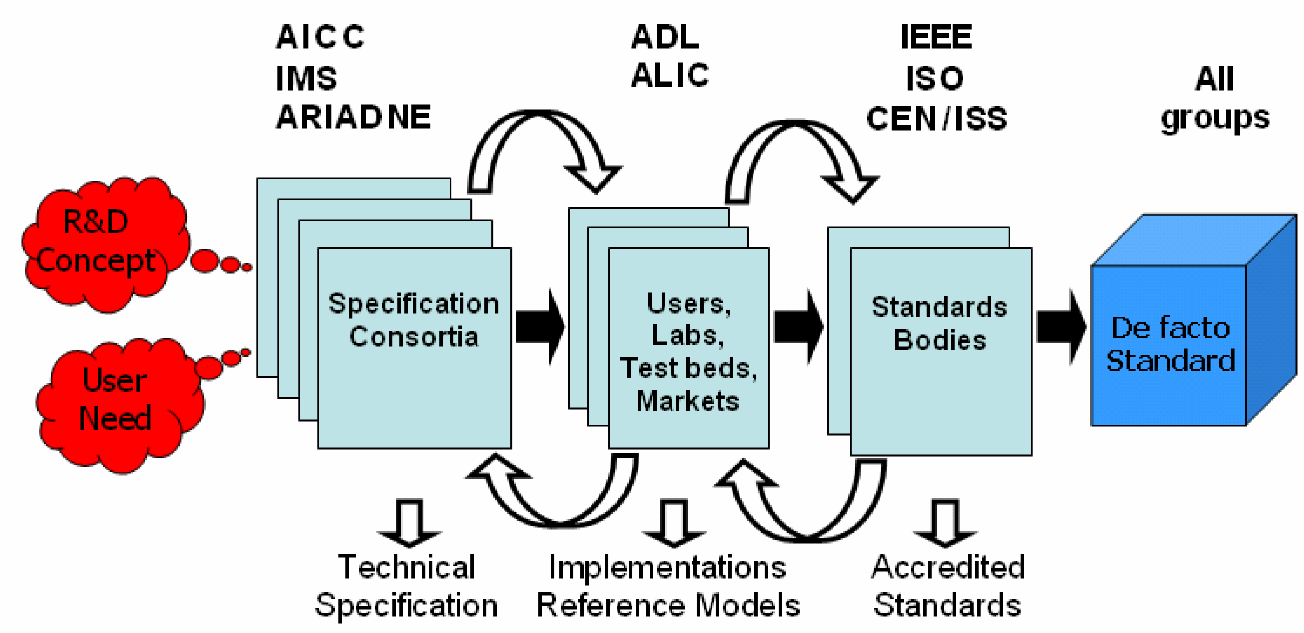
- **de jure** Standards**:**
  [By right; of right; by law; often opposed to "de facto"]
  The designation or certification of a specification's status by an accredited body such as IEEE LTSC, ISO/IECJTC1/SC36, or CEN/ISSS (European).
- **de** facto **Standards:**
  [Existing in fact whether with lawful authority or not]
  Typically, when a critical mass or majority choose to adopt and use a specification. For example, TCP/IP, HTTP, HTML, etc., are all "de facto" standards based on their common use by the majority of us.

The ideal state is when a *de jure* standard is also *de facto*! (i.e., HTTP).

Specifications evolve and become standards over time and go through several phases of development before they become widely adopted or become *de facto*. While there is no absolute process in the creation of *de jure* standards, one can abstract an overall and highly iterative process model where the following four stages are typical: (See graphic below as well.)

1. R&D: Research and development is conducted to identify possible solutions.
   Examples: The Learning Federation, overall research at universities, corporations, consortia, etc.
2. Specification Development: When a tentative solution appears to have merit, a detailed written specification must be documented so that it can be implemented and codified. Various consortia or collaborations, such as AICC and IMS, dedicate teams of people to focus on documenting the specifications.
   Examples: AICC, IMS, and ARIADNE (Europe).

3. Testing/Piloting: The specifications are put into use either in test situations or pilots to determine what works, what doesn't, what is missing, customer reactions, etc.
   Examples: ADL SCORM plugfests or co-labs.
4. Accredited and International Standard Status: The tested and roughly complete specifications are reviewed by an accredited standards body and then made broadly/globally applicable by removing any specifics of given industries, originators, etc., and taken through an open, consensus-based process to produce a working draft which is then officially balloted. If approved, the specification receives official certification by the accredited standards body and is made available to all through this body.
   Examples: IEEE Learning Technology Standards Committee (LTSC) (http://ltsc.ieee.org); ISO/IEC JTC1/SC36 (Joint Technical Committee 1 / Sub-Committee #36) (http://jtc1sc36.org); CEN/ISSS/LT-WS Learning Technology Work Shop (http://www.cenorm.be/isss/Workshop/LT).



Standards Concept

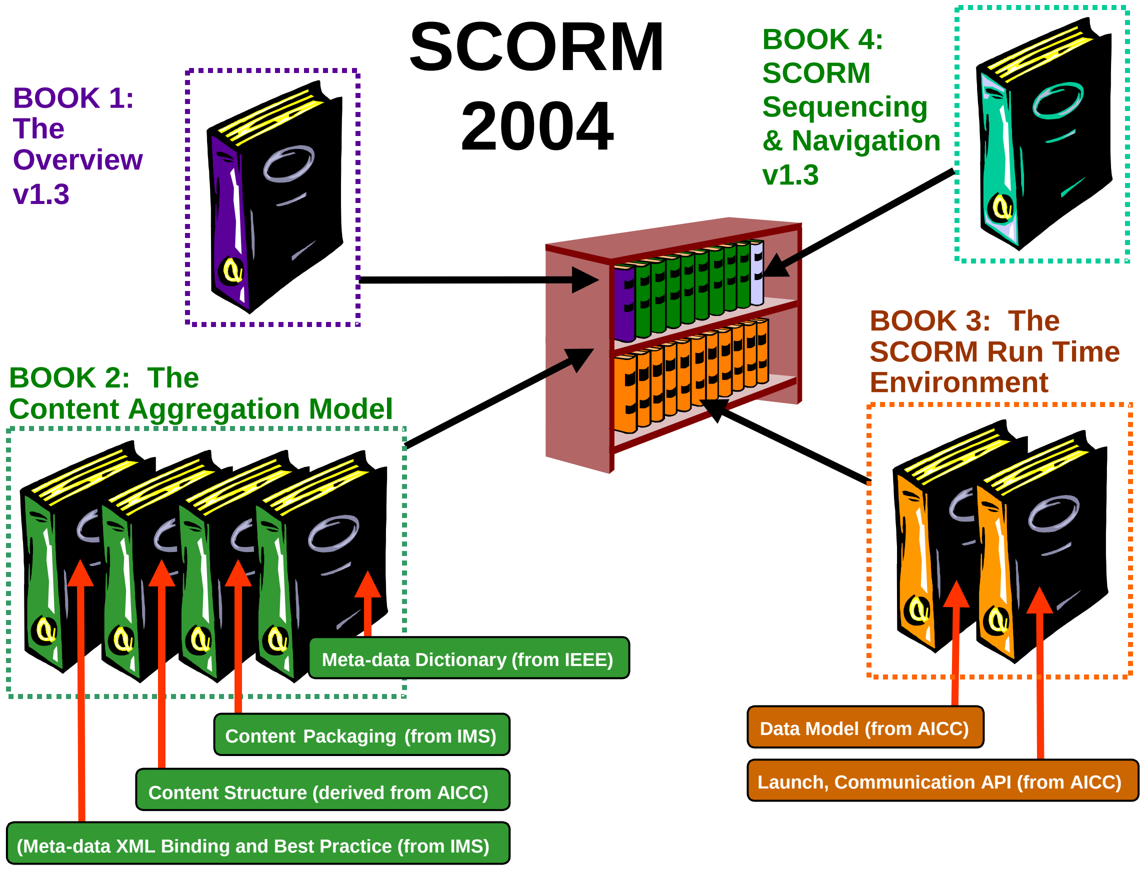
Most notably perhaps, the graphic and process above shows how the different organizations and groups cited as examples here are not in any conflict or competition with each other, as is often misunderstood. Instead these various organizations have different roles and responsibilities in a very complimentary and holistic model. Each of the standards organizations has specific milestones and project schedules for their initiatives. We recommended that you visit their particular Websites for details on their planned deliverables.

What is SCORM?

The U.S. Department of Defense and its partners initiated the Advanced Distributed Learning Initiative to ensure that all branches of the US military could use, exchange, manage, track, and re-use their learning technologies, content, and data no matter the source or application (Hodgins, 2000). Their current documentation is called the Sharable Content Object Reference Model, or SCORM. SCORM provides a foundational reference model upon which anyone can develop models of learning content and delivery. For example, systems should be able to "share" data about how learners access courses, their progress in the course, and their pretest/posttest scores. Through the application of the specifications and standards from the various groups, SCORM provides the framework and detailed implementation reference that enables content, technology, and systems using SCORM to "talk" to each other, thus ensuring interoperability, re-usability, and manageability.

SCORM is *not* a standard itself, but rather a reference model that serves to test the effectiveness and real-life application of a collection of individual specifications and standards. SCORM works with standards bodies such as AICC, IMS, and IEEE to integrate their specifications into a cohesive, usable, holistic model, and defines key interrelationships between the standards. SCORM is, in essence, a *de facto* model since this group was not chartered as a standards-approving body, but rather a model that governments around the world, as well as the learning industry as a whole, have voluntarily adopted.

The integration of these industry specifications is depicted below:



Source: ADL Technical Team

The first version of ADL's (Advanced Distributed Learning) SCORM documentation centered on Web-based learning content and was intended to enable the following:

- the ability for a Web-based Learning Management System (LMS) to launch content that was authored through tools from different vendors and to exchange data with that content
- the ability for Web-based LMS products from different vendors to launch the same executable content and exchange data with that content during execution
- the ability for multiple Web-based LMS products/environments to access a common repository of executable content and to launch such content
- the ability to move an entire course from one LMS to another (course interchange)

Now that e-Learning technology vendors have begun to adopt standards when designing their products, and now that consumers of these technologies are insisting that the products they buy conform to these emerging standards, the e-Learning industry will begin to see the proliferation of compatible, sharable Web-based content among a variety of learning technologies. This will allow the industry to move towards providing learners with the chunks of learning they need and enable organizations to track the usage of these Learning Objects.

Definition of a SCO as defined by SCORM

A Sharable Content Object (SCO) represents the lowest level of granularity of a learning resource that can be tracked by a Learning Management System (LMS). A Sharable Content Object (SCO) is a particular implementation of learning content that conforms to the SCO Reference Model (SCORM). Thus, a SCO meets the following criteria:

- contains one or more asset (electronic representations of media, text, images, sound, Web pages, assessment objects, or other pieces of data that can be delivered to a Web client).
- can locate an LMS API adapter (Learning Management System Application Profile Interface)
- contains the following minimum API calls: (LMSInitialize(“”) and LMSFinish(“”)
- cannot launch other SCOs since SCOs are sequenced by the LMS and do not "know" about when they are to be launched. (The LMS knows).

(The complete SCO specification can be found in the latest version of the SCORM documents (http://www.adlnet.org)).

To be re-usable, a SCO by itself should be as independent of learning **context** as possible so that it may be re-used in different learning experiences to fulfill different learning objectives. A SCO can be described with SCO metadata to allow for search and discovery within online repositories, thereby enhancing opportunities for re-use. In addition, SCOs can be aggregated to form a higher-level unit of instruction that fulfills higher-level learning objectives. SCOs that are context specific are often required to make re-used content make sense. In particular, with the implementation of sequencing, not all SCOs will necessarily be context free; some are scaffolding for other content.

Avoiding SCORM Misuse

Much of the confusion surrounding SCORM stems from misunderstandings of when to use SCORM and when it can be effectively adapted. When implementing SCORM, it is important to understand that:

- **SCORM does not address everything, but it doesn’t limit other things.** In other words, SCORM has proven to meet the needs of many (but not all) groups, requirements, and situations. Therefore, the recognized best practice is to use SCORM as the baseline and maximize its capabilities. When you identify needs or requirements that are not covered by SCORM capabilities, create temporary extensions and custom solutions. However, do so knowing what the risks are and base the decision on the balance between needs or requirements and understand the risk of developing without a supporting standard.

- **Use the standards and specifications within SCORM as far as they will go.**
  If your needs require functionality which is not yet covered by SCORM, and if these needs are critical to solving your priority problems, create additional solutions either yourself or with the help of others in determining the return on investment. Do so knowing the calculated risk of doing a custom or non-standard implementation.

- **SCORM assumes System Directed Learning**.
  It is intended for, and assumes, implementation and management within an IT system such as an LMS or LCMS or other management systems such as ERP.

- **SCORM uses the Web browser as its delivery platform**.

- **Individual components of SCORM may be used (e.g. packaging) while disregarding others.**
  SCORM is a comprehensive reference model made up of a series of integrated individual components. It is specifically designed to be modular in that each individual component can be implemented individually or in multiple combinations. The implementation of ALL components of SCORM is not likely or needed by most.

Implementers of SCORM will find the best SCORM-related resources on the ADL Website at http://www.adlnet.org.

SCORM Frequently Asked Questions

When will SCORM be "done"? It seems to keep changing.
ADL is nearing the final release (January 2004) of what will be known as SCORM 2004 (previously referred to as version 1.3). This release adds sequencing and includes bug fixes and updates from the previous version 1.2 and will consist of four parts:

- SCORM Overview
- SCORM Content Aggregation Model v1.3
- SCORM Run Time Environment v1.3
- SCORM Sequencing and Navigation v1.3

These will evolve separately as required over time. The Overview Book will be updated as required to point to the current versions of the other books as bug fixes, improvements, and updates to IEEE are required. If a big change occurs (due to Web services, for example), there may be a second release of SCORM 2004. Extraordinarily big changes might render the publication of SCORM 2005. None are planned at this time.

ADL believes that SCORM 2004 will be stable for some time to come. Therefore the primary focus of ADL will shift from developing the reference model specifications to assisting with the implementation of SCORM 2004 on a global scale. This will include the provision of more examples of successful implementations, sample code and tools, publishing guidelines for various groups of implementers, etc. To encourage and accelerate the adoption and adaptation of SCORM 2004 and the specifications it embodies, no new major additions are currently planned.

Is SCORM 2004 the end of SCORM?

No! While the update of the books to v1.3 marks the delivery of a stable reference model and one which meets the initial technical requirements, ADL is based on a 20 year vision for learning and performance improvement. Therefore, there are many more phases required to realize this long range vision. The decision to focus on implementation of SCORM 2004 for the next phase, rather than on the development of new versions, is a very purposeful one. Maintenance and extension are ongoing tasks for ADL. People underestimate what this takes, especially with test suites and sample open source code.

Furthermore, the development of new versions of SCORM aim to be in response to true community demands and requirements and these will best be obtained through the implementation of SCORM 2004. ADL and the growing community of implementers will be very active in gathering and compiling these new requirements to create the base for new versions of SCORM and additional new reference models needed to more fully realize and meet the Initiative's vision*: provide the highest quality education and training, anywhere and anytime.*

Is SCORM 2004 the end of ADL?

No! In fact the ADL initiative has recently been reviewed and as a result a whole new and even stronger commitment was officially announced in September of 2003. This includes the official appointment of Dr. Robert Wisher as Director of ADL and the reaffirmed commitment to the Advanced Distributed Learning Initiative by Mr. Dan Gardner, Director, Readiness and Training Policy & Programs, Office of the Secretary of Defense. Mr. Gardner reaffirmed the Department's commitment to the Advanced Learning (ADL) Initiative and pledged the DoD's continued cooperation with the Initiative's founding co-partners (the National Guard Bureau and the Department of Labor) and industry. He further noted the plans to move ADL forward as a tenet of the Training Transformation (T2) Program. "We will continue to reach out and work with our government partners and look for innovative ideas from our industry partners to achieve a global standard," Gardner said. For the full story, visit: http://www.adlnet.org/index.cfm?fuseaction=newsstory&newsid=145.

Is SCORM 2004 the only thing that ADL is working on?

No! There is a great deal of other work ADL is pursuing that will result in guidance, policy, and technical specifications that build on SCORM. There will be additional specifications which will be published to work with SCORM under different names. Another exciting example is in the area of "Handles" or Digital Object Identifiers to unite widely distributed repositories for search and resolution services, among many other things.

There are also a number of Research & Development areas ADL is working on that are at about the same stage SCORM was 5+ years ago. These will likely become a big part of ADL going forward. Near-term work is in gathering requirements for next generation architectures and tracking Internet technology evolution, as was also done in 1998.

How can I get my LMS and/or content tested for SCORM conformance?

ADL offers free test software for Learning Management Systems and for content that you can download for free and run yourself. Examples are included, including a sample LMS in which you can run your own content. Use this software to self-test for SCORM conformance.

To obtain third party certification, go to http://www.adlnet.org and look under SCORM...Certified Products for current certification facilities. These facilities will test your product for a fee and provide independent verification of conformance to SCORM. Certification is not mandated, but may be useful in the marketplace.

Do I need to be AICC, IMS, and SCORM conformant?

No. SCORM is a collection of specifications from these other sources that shows how they should work together. SCORM has additional extensions and guidance for how to make all of these specifications work properly. Therefore, if you become SCORM conformant, you are using specifications from the other groups by definition.

Aren't AICC and SCORM conformance the same thing?

No. SCORM contains things that AICC does not, such as metadata and content packaging. Also, SCORM uses a communications mechanism (now an IEEE standard) for tracking learners that is different from, and incompatible with, the AICC communications mechanisms. This means that AICC content might not be able to be imported or run in a SCORM-conforming LMS. It is true, however, that parts of SCORM were derived from AICC's CMI specifications, but they have since evolved and expanded.

Aren't IMS and SCORM conformance the same thing?

No. Some parts of SCORM are based on some IMS specifications, others are not. In most cases the parts of IMS specifications that are in SCORM have been extended and modified to work with other specifications, so conforming to IMS specifications isn't enough for compatibility with SCORM.

Will ADL add other IMS specifications into SCORM? When?
There are no immediate plans to integrate other specifications from IMS into SCORM beyond IMS Simple Sequencing, which is in SCORM 1.3.

How expensive is it to support SCORM?
It depends, but many have reported that the additional costs were less than anticipated and in a few cases a drop in costs was reported. The costs of supporting full SCORM 1.3 in LMSs vary according to the architecture and design of the system, and whether the development has been informed by specifications development over the past five years.

Content development usually has minimal costs to convert if the content is already in separate "chunks" suitable for tracking learner mastery or progress.

Does everyone need to become SCORM conformant?
No, but many will benefit from at least some parts of SCORM. Some Examples:

- If you wish to track learner progress and mastery, and use rules to determine the learner's path through content, you will want to use SCORM "Run Time Environment" and "Sequencing."

- If you don't need to track the learner but do want to export your content to other SCORM learning management environments, you will want to use Content Packaging in the "Content Aggregation Model" part of SCORM as an interchange format.

- If you want your content to be searchable and usable in particular contexts, you will probably want to use the metadata part of the "Content Aggregation Model" for tagging your content.

There are many possible ways to use the parts of SCORM.

Using Standards in your Organization

It's all well and good to be aware that standards are defined and that e-Learning vendors are conforming to those standards, but what does this mean within an implementing organization? First, understanding the standards can assist in selecting a vendor that has staying power within a constantly changing marketplace. Second, setting standards within an organization can ensure sharing and interoperability even within an organization.

Often, a company may own one, two, or even more Learning Management Systems (LMS), several libraries of Web-based, off-the-shelf content, and custom courseware authored in a variety of different tools. Figuring out how to make all of this work together and share information through a common database can be challenging. Furthermore, trying to integrate this data with an ERP system like PeopleSoft or SAP can be daunting. Consider the questions below:

- How do learning metadata standards relate to other metadata standards that may exist within the company? You may want to consider developing a metadata schema specifically for your company. What taxonomy structures does your organization need to help organize and related learning content? (For more information about metadata, see *Section 3*).
- What are the minimum requirements within the organization concerning what data needs to be captured about each learner?
- Should all custom content be authored in the same tool or at least conform to a certain set of design and metadata tagging standards?
- Should the organization have a common repository for all content, and if so, what rules will govern how the system is used?
- Will any governance structures be needed to help ensure adherence to standards within an organization? Can these be monitored and implemented by the systems and infrastructures?

When implementing standards within a company, to ensure interoperability of Web-based courseware and systems, you must gain support from senior levels of the organization. Think about whether standards need to be adhered to across the organization from the outset or whether areas within an organization should be phased into conformance as the need for interoperability increases. Sometimes it's easier to gain support for standards after some benefits can be shown, rather than trying to enforce standards on all areas all at once. Keep in mind that this is a long-term and strategic approach that will evolve and develop over a long period of time.

Talking Standards with e-Learning Suppliers

Quite often, e-Learning implementers know that they should be aware of standards but are not sure exactly which standards they should know about and how standards should be addressed with potential e-Learning suppliers. A conversation between an e-Learning consumer and supplier might go like this:

Consumer:	"Does your system conform to the industry standards?"
Supplier:	"Yes. We conform to all the latest standards."
Consumer:	“Do you conform to SCORM and AICC?”
Supplier:	“Our product is 100% compatible with SCORM and AICC standards. We haven’t had any issues integrating with any other product.”
Consumer:	"Oh, well... great!"

Too often, consumers don't feel that they know what questions to ask or even what answers they should expect to hear. Even if you haven't memorized each and every SCORM specification, you should still question vendors about their ability to integrate and ensure interoperability with other products. Some good questions include:

- "What level of involvement do you have with the various standards activities?"
- "Is anyone from your organization on any of the standards working groups? If so, what have they contributed?"
- "What are your plans for conforming with the accredited standards and the specifications as they emerge? Which specific standards or specifications does your product conform to (i.e., content metadata, content packaging, etc.)?"
- "Can you give me an example of a client who has successfully implemented your content within their LMS?"
- "Which companies are your strategic partners that offer flawless interoperability with your product? What versions of the specifications do they support?"
- "How can your company assist with our transition strategy if new standards make your existing product obsolete?"

We strongly recommend that you require vendors to spell out exactly how they will provide the functionality that you seek and require that they identify the exact specification that is associated with enabling that specific functionality. Listen closely to the supplier's answers and look for examples of how they have incorporated emerging standards into their existing product. And, if at all possible, arrange to see a demonstration of how the vendor's technology accomplishes the functionality specified by the standard. In this way, you will be able to see their level of conformance with the specification that affects the functionality you need.

It's important to remember that these standards are about the interaction of *content* itself and the system used to *manage and report* on that content. Therefore, the best way to determine if these components interact correctly is to actually try it. You should be prepared to demand a demonstration of interoperability. Asking either or both of these two questions will quickly flush out any ambiguity in the mix:

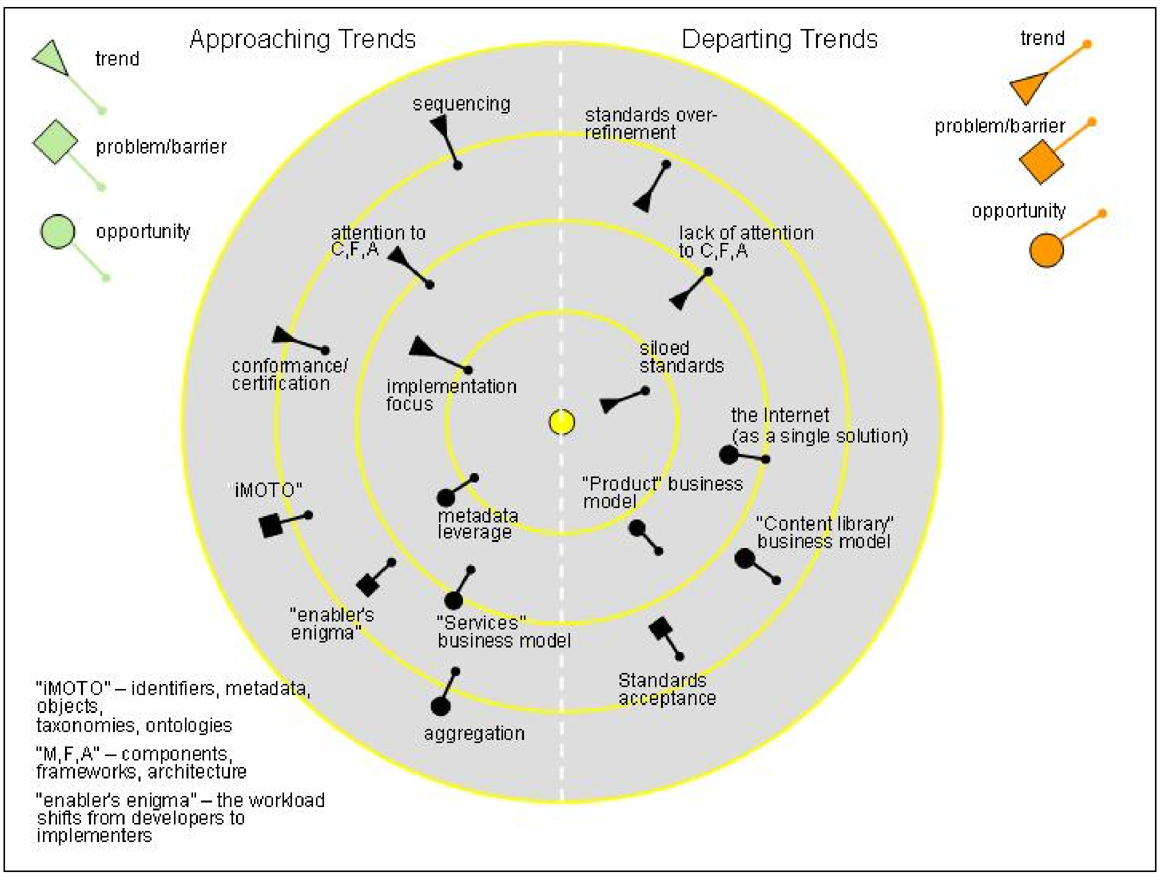
1. Does the management system vendor have a defined content certification process which certifies that a given vendor's content will run correctly on their application?
2. Can the content/authoring tool vendor provide test content for evaluation?

If you already have content and are evaluating the system piece, give the vendor representative content that you actually use—or will be using—and have them show you that all the pieces work as the standards specify. If you're evaluating content, make the vendor run some samples on *your* implementation of the management system. All standards have some room for interpretation in them; it's the nature of the beast. Vendors can be totally sincere, yet still develop different "flavors" of a standard, which can result in industry confusion and problems for implementers. When it comes to standards, it is important to pay attention to how a vendor labels a system's level of alignment with the various standards. Three terms often used are compliance, certification, and conformance. To understand the differences between these terms and which term to use, please refer to *Section 2: Understanding Conformance*.

Trends

Standards Radar Screen

This diagram is intended to provide a summary view of some trends of which you should be aware. Not all of these will be important in your implementation activities, but awareness is a good thing. The radial scale is relative and there is no claim to absolute accuracy here. Many have also found that this format is useful to develop internally within their organizations and as a tool to stimulate and capture discussions on relevant trends and directions.



The Enabler's Enigma, iMOTO, and CFA (*Components, Frameworks*, *and Architecture*) are three "approaching trends" on the Standards Radar Screen. The following three sections are primers on these concepts.

The Enabler's Enigma

A major change since 2001 is the shift of focus from those developing standards to those implementing them. This is part of a much larger trend and a critical transition point between those responsible for creating what might be called enablers and those who are using and benefiting from these enablers. Enablers would include such things as technology, standards, and conceptual models that enable one to do something they could not do before due to lack of knowledge, skill, resources, budget, etc.

The critical point or "enigma" is that only the individual communities of practice, organizations, companies, and professions can and must take responsibility for this implementation. Therefore, the success of standards will be determined by how well and how broadly these enablers are voluntarily adopted and adapted. As such, we will see the accelerated transition to an overall consumer-centric and learner-centric future.

And just what do these communities of practice, companies, professions, and organizations, need to take responsibility for and work on? Where do you start? At the risk of introducing yet another acronym, "iMOTO" represents 5 categories, all of them related to metadata, which have proven to be the key focus points. iMOTO stands for identifiers, Metadata, Objects, Taxonomies, and Ontologies.

iMOTO

Identifiers

Sometimes referred to as GUID, these Globally Unique IDentifiers are independent, persistent identifiers for every "thing." This is comparable to having a unique part number for every item, assembly, or collection. Persistence is vital to ensure the identifiers will remain intact and accessible. This often requires a registry service to manage them. When you begin to consider enabling global access to these so that each "object" can be discovered, the importance and magnitude begin to become clear. In this context, it is critical that when implementing metadata standards there is a process and a capability to create and assign a GUID to every asset, no matter how large or small, that will be used or referenced for learning.

Metadata

This is perhaps the best understood of these 5 areas, as it has been the focus of standards and implementations for some time. Metadata can be thought of as the subjective and objective data that describes the attributes and characteristics of not only content or "data," for which it most is often noted, but also people, places, and things. If you want to find it, refer to it, or use it, metadata is needed.

As with many of these categories, it sounds deceptively simple. However, as is often the case, many challenges exist in the details of implementation. The lessons learned by those with experience implementing metadata include the following:

- Develop and publish a set of policies and procedures for the creation and management of metadata
- Involve as many different user communities in the development or review of these metadata policies
- Use existing cases and content to determine which metadata elements are required
- Go for the minimum possible metadata elements or fields
- Develop different metadata requirements for the different types and levels of assets the metadata is describing. With SCORM-based content, for example, there is a different set of required metadata for raw assets, SCOs (Sharable Content Objects) and whole courses.

Objects

This is the smallest unit of text, image, sound, video, or data that is both useful and self-contained. Conceptually, "objects" covers any and all assets. These include people's skills, competencies, and knowledge, as well as such things as buildings and equipment. The critical point for implementers is to develop the conceptual models and frameworks for a modular-, component-, or object-based approach. Using content or Learning Objects as the example, it is important to develop a model for the different levels of content granularity above and below Learning Objects. What is the lowest or smallest level of granularity? What is the next layer above this and how is that layer assembled? Refer to Section 3 on Learning Objects for more details.

Taxonomies

These are general principles of classification. For more details, see Taxonomies on page 32 in *Section 3* and in *Appendix 2*.

Ontologies

Ontologies are the relationships between items classified in taxonomy. They enable us to capture a representation of knowledge. Capturing these relationships between items in a taxonomy enables some extremely powerful capabilities such as inference. For example, metadata and taxonomies enable the capture of something such as, "Upon receipt of this `PurchaseOrder` message, transfer `Amount` dollars from `AccountFrom` to `AccountTo` and ship `Product`." However, this would not enable any reasoning outside of these parameters. Ontologies provide this ability by enabling a mechanism to conclude that because the `Product` is a type of Chardonnay it must also be a white wine.

CFA: Components, Frameworks and Architectures

Using a building comparison, we can abstract three critical layers or levels that are proving to be equally helpful to standards implementers. These are characterized as Components, Frameworks, and Architectures (CFA). Benefits and uses for these levels include such diverse applications as differentiating the requirements for metadata, organizing teams to work on these requirements, determining required skills, and choosing which technology to apply to the different areas.

Components

Continuing the building analogy, this refers to the pre-built assemblies used in the construction of most buildings such as door assemblies, window units, lighting and bathroom fixtures, etc. While there is a level below these components such as the hinges and hardware in a window assembly or the parts within a toilet, this component level represents the lowest level of granularity that most people need to worry about and designers need to work with. Mapping this level of components over to a learning application, components would represent such things as paragraphs of text, illustrations, animations, and audio clips.

Frameworks

In the building analogy, frameworks would represent the rooms of a house or building, including kitchens, hallways, entrances, foyer, and bedrooms. Each room is a complete unit with its own requirements and consists mostly of a careful selection and assembly of the components level. It is worth noting that in the evolution of the building industry, it was once thought that these rooms would be the most common level to be standardized and there was much hype and promise for the so called “modular housing” approach. This model envisioned everyone designing their homes by selecting just the right individual rooms, pre-built and shipped to the building site to be “snapped” together to create a finished home. However, this level proved to be too large and monolithic. Most people wanted to modify each room and thus found that none of the individual pre-designed rooms was “just right” for them. Rooms would compare to lessons in the learning content comparison.

Architectures

To complete the context and utility of this overall model, the components and frameworks of rooms need to be put together into a complete home or building. In turn, this needs to be adapted to suit the building site, neighborhood, country, culture, etc. In the comparison to learning content, the same degree of wholeness, context, and fit are required in order to match the needs of the learner, the tasks they need to perform, their location, etc.

The main purpose of noting these three different layers is to assist standards implementers by enabling both a focus on the individual levels as well as their overall integration into a complete and well-functioning whole. Those who have experience in such implementations have said this type of delineation helped them organize their teams, specify their outsourcing, develop effective RFPs, and both understand and implement the different individual standards.

Section 2: Understanding Conformance

Which Term Should You Use – Compliance or Conformance?

Most Learning Management System or content vendors today claim some sort of compliance or conformance to the latest learning standards. As a result, these terms are used freely, without a real understanding of their meaning, and to add to the confusion, are often used interchangeably. We recommend that conformance be the term used and that you avoid the use of the term compliance. This is both for clarity and accuracy as you read this section.

The term compliant (an adjective) means "conforming to requirements," but the real issue is "to follow a standard," as represented by the action verb "conform." Beyond this initial explanation, this section seeks to provide a clear and concise understanding of conformance and how it relates to a product's adherence to an individual specification or standard.

Conformance

Conformance is usually defined as testing to see if an implementation (i.e., product or application) meets the requirements of a standard or specification [Gray, Goldfine, Rosenthal, Carnahan; NIST/ITL, January 2000]. *What* can *be tested is conformance to a specific version of a given standard or specification.* Standards and/or specifications exist for content metadata, content packaging, content sequencing, question and test interoperability, learner profiles, run-time interaction, etc. *It is important to realize that there is no such thing as conformance to a collection of standards or to a group such as IEEE, IMS, AICC, SCORM, or ARIADNE.*

A buyer's or supplier's interest in conformance should be based on those requirements (content metadata, content packaging, content sequencing, question and test interoperability, learner profiles, run-time interaction, etc.) which are relevant to their needs. Just accepting (buyer) or claiming (suppliers) conformance is not enough. You need to focus on how a given standard or specification will meet your specific needs.

For instance, you might have determined that you need to be able to improve the success of your people in getting the content that will best meet their learning needs. Since "metadata" is the "information" on learners and content that will enable this need to be met, buyers and suppliers should focus their discussion on the degree to which tools, systems, or content that are under consideration "conform" to "metadata" standards and specifications.

Conformance Testing

Conformance testing is a process of verifying adherence to a standard (not product quality). Conformance testing is generally affiliated with a formal conformance-testing and certification program. For example, consider the telephone; an FCC sticker indicates that it has been certified by the FCC as adhering to certain standards for telephones.

How do agencies test for conformance? A test suite, which is a combination of test software, test procedures, and test documentation, is used to check a product for conformance. The test software consists of a set of test files (i.e., data, programs, or scripts; it checks each requirement to determine whether the results produced by the product match the expected results. The test procedures define the administrative and technical processes for testing a product. The test documentation describes how the testing is to be done.

Certification

Certification is the acknowledgment that testing has been completed and that the criteria of the specification have been met. Certification validates a product's conformance for interoperability and re-use. A certificate-issuing body is responsible for issuing certificates for products determined to be conformant. While there could be several certifying bodies for a specification, there can be only one sponsor, or "owner," of the conformance-testing program. The sponsor establishes and maintains the program and ensures that the necessary components of the program are in place.

There are two types of ADL certifications for SCORM. One is for LMSs and the other is for content. The process is slightly different depending upon whether you are testing an LMS or content. There is currently no certification available for either a developer or for tools.

Complete information about the certification process is available at http://www.adlnet.org/index.cfm?fuseaction=scormprod.

Product Self-Test

A product self-test provides a less formal means for developers and users to assess for themselves the ability of their product to conform to the relevant standard. It allows them to identify and correct problems that may prevent the product from passing formal conformance testing as described above. These publicly available self-test suites are not affiliated with any formal conformance-testing and certification program. You can find some at http://www.adlnet.org/.

Stuff that Works!

Conformance/certification only really matters to most people to the extent that it results in "stuff that works." In other words, "is the content consistently viewable and usable by the audience it is intended for?"

Certainly, achieving certification is an ideal, but buyers must realize that not all technologies may be certified. This is especially true for e-Learning, as it is a relatively new industry and certification processes are not in place for all standards. Furthermore, standards may not always remain the same, so a certification today may not be 100% guaranteed of future product viability. The previous example of the video industry applies here as well. Early on, two sets of standards emerged: Betamax and VHS. Ultimately, VHS was more widely adopted and survived, while Betamax owners found their VCRs and tapes obsolete. VHS standards seemed fairly safe for some time, but then technology moved on, and now the adoption of DVDs are winning out over VHS technology and will soon render videotapes a thing of the past.

An "assertion of reasonableness" should be discussed between the e-Learning vendor and the consumer to agree upon a satisfactory level of understanding that content may be created to be in alignment with standards, but guarantees of certification or even conformance may not be possible. As was noted in the "Talking Standards With e-Learning Suppliers" section, there is no substitute for actually seeing it work. Therefore, in addition to all the due diligence around formal standards we have been discussing, be sure to require a real test of the real pieces that define your particular situation.

Future Proof?

How will a buyer know which standards are "safe bets"? Standards that focus on more human factors, or the needs of learners, will most likely remain more constant over time, while technology and the corresponding standards will tend to evolve over time resulting in newer versions. For example, the "need" to be able to record and view movies has remained the same, but the technology and thus the standards used to enable that need, have evolved.

Enablers, Not Guarantees

Lastly and perhaps most importantly, keep in mind that adherence to specifications and standards does *not* guarantee or imply that the results of learning from using these products and content will be better or of higher quality. Using the video analogy, we understand that while having the VHS standard has been a critical factor in what we now know as the video industry, VHS does not have much impact on the quality or effectiveness of what is contained on a videotape. Similarly then, all the work on standards and specifications will play a similarly critical role in causing the take-off of the learning industry, they do not, in and of themselves, look after ensuring the quality or effectiveness of learning.

Perhaps standards and specifications are best characterized as "enablers" in that they make the vision of increased effectiveness of learning and of personalization possible, but do not, in and of themselves, ensure it will happen. Learning must be built upon a foundation of common de-facto standards. And, we must continue to focus on measuring and attaining increased effectiveness of learning and the increased human performance and productivity this produces.

Section 3: Metadata

What is Metadata?

The field of e-Learning is constantly growing, as are the vast sources of information available and appropriate for learning. Because of this, it is getting more and more difficult to find and assemble "just the right" and relevant information. The purpose and usefulness of metadata in e-Learning are that it provides the ability to richly describe and identify content so that we can find, assemble, and deliver the right content to the right person at the right time. While there is not sufficient space to cover it here, it is worth noting that metadata applies well beyond just content and includes literally any and all other resources such as software code, equipment, and even people and their competencies.

Simply defined, metadata is the data which describes things. It is "meta" because it applies to anything we want to reference, point to, locate, or re-use. As such, metadata is a wonderful example of the power of simple things. Metadata could be as objective and straightforward as the author of a book, the file size of an animation, or the location of a file in a database. It can also be as complex and subjective as the learning preferences or styles of an individual, the collective opinion of a group who has seen the same movie, or which quote is the favorite among those that capture a profound idea. Content is increasingly being broken down into smaller pieces so that it can be mixed, matched, and assembled into highly relevant and mass customized Learning Objects tailored to match specific needs of specific individuals. Without metadata, we would drown in the chaos and inefficiency resulting from an overflowing sea of unidentified Learning Objects, content, code, and most other "things."

What should metadata mean to you? It is the means to fully describe and identify every piece of content and every resource useful for learning, and enable you to efficiently find, select, retrieve, combine, use, and repurpose these resources. Metadata is the key enabler for personalized learning experiences or, as stated in the introduction, for getting it "just right."

Metadata can, and ideally needs to be, applied to all sizes and types of content and resources used for learning, from the smallest piece of raw data, or asset, all the way up to a complete course or curriculum. Using metadata this way allows each level of content to be easily searchable and re-usable. For example, it is just as easy to find and re-use one piece of text or illustration, one page in a chapter, one chapter of a course, or an entire course. But that's not all! Apply the same concept of metadata to people, places, and things, and the real magic begins! For people, this could include the attributes describing something as simple as their name, address, and phone number, to more complex characteristics such as their learning preferences, skills, and buying habits. All these are examples of metadata. You can start to imagine what happens when metadata is used to filter, select, and assemble just the right bits of learning content, personalized "just right for you" and delivered on just the right device in just the right way! This is the vision of truly personalized learning and living.

How does metadata work in the e-Learning world today? Four main uses of metadata point to its inherent value to individuals and organizations: Categorization, Taxonomies, Re-Use, and Dynamic Assemblies. Each one enables reduced cost and significant timesaving as well as human performance improvement.

Categorization

One of the first and most common uses of metadata comes when it is used to add value by organizing information into categories. Good examples are the Yahoo! search categories which make looking for information on the Web (i.e., autos, entertainment, health, etc.) much easier and faster. Finding information faster obviously saves time, money, and frustration. It also significantly improves productivity and job performance. However, doing this across different systems, organizations, countries, and disciplines can only be achieved when a common metadata standard is adopted and implemented.

Taxonomies

While it is useful to organize content into categories, it is even more powerful to structure and organize metadata categories into ordered groups of relationships known as taxonomies. Most of us learned about taxonomies in biology class when we studied the classification of plants and animals into a hierarchical structure of kingdom, phylum, class, order, family, genus, and species. As in biology, there are enormous benefits from having such a structure or taxonomy for metadata. It can organize the content and also capture the relationships between categories. In this way, metadata taxonomies allow different systems and structures to be recognized, translated, and understood.

Imagine that you are trying to explain the structure of the school system in your country to someone from a far away country who knows nothing about your system of education. You would likely refer to the hierarchical system of classes or grade levels or years (a taxonomy), and then use this taxonomy to compare, contrast, and "map" to their country's system. Can you start to see the power and value of taxonomies in understanding and translating different categorical systems? The same is true with learning content. If all of the attributes (metadata) about learning content are recorded in a common structure or taxonomy, both the metadata *and* the learning content can be integrated into universally searchable and virtually centralized catalogs and databases which span multiple systems, audiences, and countries.

Re-Use

As content and metadata become more structured and their granular size decreases, the re-usability of the content and the metadata begins to increase exponentially. It is not hard to see how this ability to create once and re-use multiple times can provide some of the highest multipliers and return on investment (ROI) imaginable. Once again, metadata plays a pivotal role.

Current impediments to sharing or re-using information across organizational boundaries are the high cost, time, and difficulty of reformatting, re-categorizing, editing out examples that are irrelevant to the new audience, and integrating it all to match organization-specific circumstances, disciplines, and proprietary information. The key is to have structured data that is broken down into small individual blocks of information, each one tagged with appropriate metadata so they can be discovered and selected to match the requirements at hand and then assembled into a "just right" package of content. This dramatically increases the ability to re-use individual information blocks for completely different purposes or put them into different contexts by choosing just the ones needed and assembling them in the right sequence, to the right medium or device.

For example, an in-house course in business ethics might contain 80% non-proprietary content that could be sold and re-used by other organizations that combine it with their 20% proprietary or unique information on business ethics. In this case, re-use outside the initial organization would be difficult if this content were one contiguous course. However, if the course were an assembly of individual information blocks, the whole assembly could be "dismantled" and put back into the repository or warehouse with all the other information blocks. Then, a new assembly will have been created in response to a new set of criteria, which might be slightly or very different from the original.

Dynamic Assemblies

Let's put this all together, literally! Information can only be re-used to the degree that it can be flexibly and, best of all, dynamically assembled into "just the right stuff" for just the right person, in the right media format, in the right language, delivered to the right location, on the right device, at the right time. Let's look at an example of how an Electronic Document Management System (EDMS) or Learning Content Management System (LCMS) could pick and choose just the right content and assemble it by applying rules to metadata. Let's say a civil engineer in a remote field location in England needs to learn how to survey. The field engineer is using a wireless device and needs her information in metric units. The system would select "just the right" bits of data for her, choose examples in metric units, match similar characteristics of that location and job, choose the content types that are ideal for small onscreen viewing only (animations, etc., rather than print), assemble this into one or more "just right" Learning Object(s), and deliver them via satellite cellular connections to her wireless device. As the civil engineer uses these Learning Objects, metadata in the form of learner usage data is created and sent back to the repository in the EDMS or LCMS for future analysis.

In summary, the four main uses of metadata described above help to explain that while the ultimate goal of personalized, profoundly effective and scalable learning is not immediately upon us, it is within our grasp if we embrace standards-based metadata.

Metadata Example

In the very simple example below, there are three metadata elements or "tags" used to describe a specific Learning Object. From this example, we know that the content's **status** is "in review," the **author** of this content is "John Q. Adams," and the **instructional designer** is "Louisa Jones." Notice that some meta-data attributes are pre-determined choices and others are manually entered. As seen in this example, one metadata element can carry multiple values. In some systems, meta-data attributes can be automatically populated with values that are associated with the person who modifies the Learning Object.

NOTE: The element numbering below is simply the numbering scheme used within the IEEE Learning Object Metadata (LOM) standard and SCORM documents.

LOM SCORM Element#	element name	metadata vocabulary	metadata value
2.2	**status**	- Draft - In review - Approved - Effective - Released - Retired	In review
2.3.1	**role**	- Author - Editor - Publisher - Validator - Project Manager - Instructor - Quality Reviewer - Legal Review - Regulatory Review - Graphical Designer - Content Provider - Script Writer - Instructional Designer - Subject Matter Expert	author
2.3.1	**role**	- Author - Editor - Publisher - Validator - Project Manager - Instructor - Quality Reviewer - Legal Review - Regulatory Review - Graphical Designer - Content Provider - Script Writer - Instructional Designer - Subject Matter Expert	Instructional designer
2.3.2	**entity**		John Q. Adams
2.3.2	**entity**		Louisa Jones

Recommendations for Implementing Metadata

Metadata is one of those things which are as simple in concept as they are difficult to implement. As the saying goes, "The devil is in the details," and there are a myriad of details to deal with when implementing metadata. This is not meant to scare anyone away from doing so but to ensure that expectations are reasonable. As with creating a process or system, the investment in upfront design and care and attention when building the infrastructure pay huge dividends when the final product is up and running.

This section will provide some general recommendations on what to consider when getting started with metadata. Much of this has been gleaned from those who have gone before and their lessons learned.

> *See also:*
> 1. *For some high level considerations on metadata and some related categories to consider as you get going with metadata, please refer to the primer on iMOTO. This will put metadata into a larger perspective and cover additional topics of globally unique identifiers, taxonomies, and ontologies.*
> 2. *It is highly recommended to be familiar with the "Metadata Principles & Practicalities" document for a list of founding principles shared by almost all metadata groups such as Dublin Core, IEEE LOM, IMS, ARIADNE, GEM, EdNA and many more. This document also contains a very useful coverage of appropriate "practicalities" which any implementer would do well to take into full consideration.*

Top Eleven Metadata Myths to Kill

As with anything new and complex there are a number of misunderstandings and misconceptions about metadata which have emerged over the past few years. To assist with the smooth implementation of metadata, the following "myths" are worth noting and understanding so as to prevent unnecessary distractions and misdirection.

> *Please note that no meaning is implied by the order.*
> *Numbers are assigned for reference purposes only.*

Myth I: Some metadata elements are required or mandatory.

This is not true in terms of the standards themselves, such as the IEEE Learning Object Metadata standard, however it is often true as a *policy* of a given community. Surprising to many, there are NO mandatory or required elements in the LOM standard. This is most deliberate on behalf of the standards committee in order to ensure maximum flexibility of the LOM standard and thus encourage maximum adoption. Deciding which elements to use (see also Myth II) and which, if any, to make mandatory, is only appropriate for those who will create and use the metadata. Equally, as LOM is intended to describe the attributes of literally any “thing” that can be used or referenced in learning, this degree of flexibility is critical. For example, the metadata required to describe a single illustration would be much different from that needed to describe a whole course. Therefore each community of practice will want to make its own decisions as to which elements to use and which ones to make mandatory or optional. Examples of this setting of mandatory metadata elements can be seen in SCORM as well as further decisions from groups such as CanCore and IMS.

Furthermore, it will be necessary to determine groupings of the resources for which metadata will be developed. It will be likely necessary to create specific metadata requirements and policies for each group or level. SCORM, for example, differentiates between the metadata for courses, distinct from the metadata for content and metadata for raw assets.

Myth II: If you use LOM, all elements must be used.

Counting every single metadata element or “leaf” in the LOM standard, there are almost 80. With multiples allowed of many of these, the number can easily climb to over 100. This has caused more than one group to either give up or never begin.

However, there are *no* mandatory elements as far as the LOM standard is concerned. As per the previous myth about required elements, there are none here. Each group must either adopt or develop its own such list. Therefore, there are implementations of metadata which range from using 5 to almost 100 elements. Perhaps even more important is to note that both the number of elements used and *which* elements are used is critically dependent upon *what* the metadata is describing. A paragraph of text will require very different attributes or metadata elements than would a book.

Myth III: You must choose one metadata standard.

While this is clearly desirable in terms of developing a metadata strategy or implementation plan, the benefit of standards is that even when there are multiple standards for similar purposes, it is possible to “map” or convert from one to another. While not ideal, this will likely be the reality for some time to come. It is therefore possible and sometimes necessary to do what is sometimes called “cross walking” from one standard to another. Such cross-walks have been developed to assist in traversing metadata from such groups as Dublin Core, MARC, and LOM.

Myth IV: Every resource has one metadata record (set of elements).

Actually, quite the opposite is true. Theoretically there could be an infinite number of metadata records for the same individual learning resource. This is necessary and caused by the multitude of different perspectives, uses, and types of learning resources and the subjectivity of many elements. Even something as apparently straightforward as *typical age range* could vary considerably. For example, what is the “typical age range” of the learner for one of Van Gogh’s paintings?

Myth V: All metadata must come from a single record.

This myth is likely the result of the common comparison of library cards as an example of metadata. It is also related to the mistaken assumption that all metadata is objective (Myth VI).

Resource discovery is one of the fundamental benefits that metadata can provide. Therefore, it is important to be able to gather or "harvest" metadata from *any* source of metadata elements. When a query is made (looking for some number of specific metadata elements), it is important that elements can be found in multiple metadata collections or repositories. This is important to both facilitate the discovery of the best resource that matches the query and to enable the largest possible discovery of resources.

Take a simple example of a query to find the most recent version of an illustration of the human heart that is in color and suitable for 14 year olds who are doing their first anatomy course. When the query successfully returns "just the right" illustration, it could well be that it did so by finding EACH one of the metadata elements in the query (illustration – most recent – human heart, etc.) in a different metadata record stored in a different repository of metadata records and created with different metadata standards (MARC, Dublin Core, LOM). Each one of these metadata records and elements is pointing to the exact same illustration. However, the ability to query each of these metadata repositories and find at least one of the specified metadata elements, confirms that this one illustration matches all or most of the total elements in the query.

This type of searching and these types of metadata repositories which can consist of multiple individual repositories are often referred to as "federated."

Myth VI: Metadata is all objective.

Many of the metadata elements are very objective in that they define characteristics which are objective such as the title, author's name, date created, etc. Equally, however, many metadata elements are very subjective in that they are based on an opinion or perspective relevant to the community using the resource. A triangle could be used mathematically, graphically, or artistically. Relative to improving learning, it is often the more subjective metadata that proves to be the most important in finding the best resource for a given student or learning objective. What would be most valuable in helping you find a good book to read: the objective metadata about author, style of writing, genre, etc. or the opinion of the value of this book by a group of your peers?

In no way is this meant to imply that subjective is "better" or more important than objective metadata. Rather, it is meant to highlight that metadata applies to the full spectrum and that both are likely necessary.

Myth VII: Authors must create the metadata.

The source of metadata is also something that will vary dramatically. The presence of a broad range of individuals and groups contributing to the available metadata for a given learning resource will likely improve the metadata's quality in terms of usefulness. It is often mistakenly assumed that it is the responsibility of the original resource creators (such as authors) to also supply the metadata. Others might think that this is the domain of librarians or indexers. While all of these groups are likely to be able to contribute significantly to the metadata elements available for a given resource, so too would many other groups such as teachers, managers, publishers, associations, and learners themselves!

Myth VIII: All metadata must be manually entered.

One of the longest standing and widely held myths, this is critical to "kill." If not, the metadata gathered and available will be severely constrained. Much metadata has been and will continue to be created manually but there is no reason for this to continue and it is evident that this method does not scale well and typically creates many errors and low-quality metadata. Therefore, steps must be taken towards minimizing manual metadata generation and maximizing automatic methods.

Quoting from the "Metadata Principles & Practicalities" paper cited in the box on page 35:

> "Web search engines harvest and index a significant portion of the Internet and provide low cost index access to it, generally in an advertiser-supported model. Such indexing can be thought of as a kind of metadata, and for many information needs, it provides a surprisingly cost effective solution to resource discovery.
>
> Between these two extremes (manual and automatic) lies a broad range of metadata creation that can be automated to some degree, and which can be expected to grow in importance as advances in such areas as natural language processing, data mining, profile and pattern recognition algorithms become more effective.
>
> Content creation applications (word processors, electronic paper such as PDF, and Website creation tools) often have facilities for author-supplied attributes or automated capture of attributes that can simplify the creation of metadata. As these facilities grow more sophisticated, it will be easier and more natural to combine application-supplied metadata (e.g. creation dates, tagged structural elements, file formats and related information), creator-supplied metadata (keywords, authors, affiliations, for example) and inference-based metadata (classification metadata based on automated classification algorithms, for example). Combining attributes from these approaches will increase the quality and reduce the cost of metadata descriptions."

Myth IX: Forms are the way to create metadata.

It is typical to use fill-in-the-blank type forms or pull-down lists to gather metadata from those creating it. Although this works, eliminating or minimizing such form-based and overall manual metadata entry will greatly improve the quantity and quality of metadata. Two of the most effective ways to attain this goal are to focus on necessary metadata rather than "just in case" metadata and to seek every possible way to automate metadata creation.

Myth X: If you use LOM, you must use LOM element names.

This myth also vies for top billing on the list and is similarly important to eliminate. Two points in particular are relevant here: First, the LOM standard and its language is intended to provide guidance and specifications for groups such as tool developers. Second, the terms used for each metadata element are only "tokens" and are intended to be replaced by words meaningful to those using them. It is unlikely that LOM element names such as "semantic density," "interactivity level," or "intended end user role" are appropriate labels for most communities creating or using metadata contained within these elements. Instead, the intent of the LOM standard is to have each community of users determine the terms or tokens that make sense to them and use these. As a result, interoperability is maintained because the meaning or semantics of the element are maintained; just the term used to reference this element is changed. As this is a specifically-known LOM element, the term or token used makes no difference to the system which manages the metadata, but matters a great deal to the users interacting with the system or the metadata and content.

Myth XI: Changing element vocabulary breaks the standard.

Actually, quite the opposite is true. LOM was designed to be extendible and adaptive. More accurately, every organization or community needs to decide on the terms and vocabulary to use within many of the elements.

Lessons Learned: Practical Suggestions for Implementers

Thanks to some CONSORTIUM members who were willing to share their experiences with implementing metadata, here are some pragmatic recommendations and suggestions worthy of your consideration as you develop your plans to implement metadata in your organization. Some of these groups have significant amounts of experience.

Please note that no meaning is implied by the order. *Numbers are assigned for referencing purposes only.*

General Recommendations

1) For developing and implementing metadata within an organization, set expectations to the degree of difficulty and duration:
    a. It will be more of a marathon than a sprint and should be viewed as the development of a process model and policies for long-term use rather than simply a project. Many experiences show that it has taken a year for organizations to define metadata for their needs. They are still "tweaking" because it is necessary for their metadata to be integrated with such things as their LMS or ERP systems and for content repositories to exchange (meta) data.
    b. As the number of implementations continues to increase, this collective experience will reduce the time it takes for new adoptions and implementations. We are already seeing a significant increase

in the number of "lessons learned" published or presented at conferences and in the number of guidelines and examples available to assist new implementations. See the Additional Resources for further reference.

2) Some of the key success factors within an organization include:
    a. Having executive level championship. (Interest or approval will not likely be sufficient).
    b. Clear articulation to the organization about the benefits of using metadata, including direct ties to organizational goals and ROI. This should not be confused with pedagogical or other reasons those involved might tend to emphasize.
    c. The commitment of the organization (and standard procedures) to a process which all "content managers" employ appropriately.
    d. All content managers must comply with mandatory tags, though some systems may not be able to enforce this.

WHO?

3) Use a collaborative approach:
    a. If there are multiple learning groups within your organization, involve them in the decision-making process, especially if content can be leveraged between multiple learning groups.
    b. Many organizations may already have metadata that is used somewhere within their organization—most likely it would be associated with a group that manages documents.

4) Make the implementation of Learning Object Metadata an integrated effort between learning management and IT or the group that manages metadata. This is especially important if pre-existing metadata tagged documents become Learning Objects to be delivered through your LMS and/or managed via your LCMS.

5) Involve those who manage metadata, such as IT or the library department, because Learning Object Metadata has to fit into the broader metadata schemata within your organization. This work may include the "mapping" of metadata tags across multiple taxonomy structures.

6) If at all possible, involve someone with metadata and taxonomy experience who can guide the learning group through its decision-making process.

7) Think of the life-cycle of a Learning Object (from original creation to modification to retirement) and who has to "touch it." They can provide information regarding what kinds of attributes they would like to store within a metadata scheme.

HOW?

8) Develop plans and procedures for the assignment of metadata as part of the authoring, review, editing, quality assurance, etc., workflow stages of the Learning Object:
    a. The entry of metadata might be best served by a "shared" entry workflow process amongst multiple “content assemblers.”
    b. This involves defining routing and life-cycle management for your Learning Objects.
    c. It also involves creating a system that recognizes roles for individuals who create, edit, manage, and aggregate Learning Objects.
    d. Each role can be responsible for entry of specific metadata tags; this is more complex, but may be more efficient for your organization.

9) Give careful consideration to how metadata will be used throughout the life-cycle of content:
    a. Include metadata values for creation, review cycles, multiple modifications, and ultimate retirement of Learning Objects.
    b. Many organizations need to keep a copy of all learning content for regulatory reasons.
    c. Metadata can help synchronize versions of learning content to specific learning assignments for your learners and this can help ensure an accurate audit trail for training records.

10) It is strongly recommended to create standard operating procedures around content entry into a common content repository:
    a. The implication is that you would have a common content repository, which takes a great deal of planning, organizational commitment and investment.
    b. This involves creating a taxonomy for the creation and management of Learning Objects.
    c. This becomes the basis for such critical issues as metadata structures, system notifications, and security.
    d. Take into consideration how different metadata taxonomies can help, yet complicate the matter. *See also the primer on iMOTO.

Metadata Element Decisions:

11) In choosing metadata elements/tags consider the following:
    a. Most groups choose to adopt and use SCORM values, but they also add LMS-specific and company-specific metadata to their Learning Object Metadata structures.
    b. Related questions include:
        i. How many fields are needed? (Differentiate luxury from necessity).
        ii. Which are required vs. optional? (Keep “required” to a minimum).

iii. Which, if any, apply to course level, module/object level, and raw media/asset level?

c. Agreement of mandatory vs. recommended metadata is not easy and may vary from group to group.

This is much easier to accomplish if your underlying technology infrastructures, such as content management, can handle different "object types."

12) Your organization's metadata should include values from any other systems which will be integrated such as LMS, LCMS, ERP, CRM, KM, etc.

Yes, it is worth it!!

In conclusion, while these recommendations clearly show that the task of metadata implementation within an organization is a daunting one, groups who have carried out the initiative report that the benefits of metadata are continuously expanding across their organizations. One only needs to conduct a Web search on recent metadata articles, news items, conferences, and tool developments for further evidence. Whether in academia, government, or the corporate world, metadata is emerging as one of the cornerstones of more effective learning as well as more efficient storage, retrieval, assembly, use, and overall strategic management of literally all resources and assets. It may not be fast, cheap, nor easy— but, it *will* be worth it!

Section 4: Learning Objects -- Building Blocks for Learning

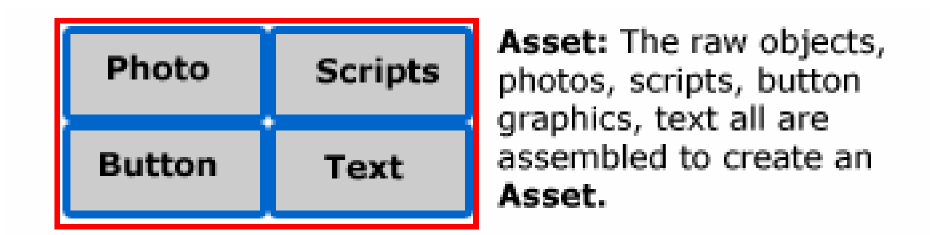
The Learning Object (LO)

The emergence of learning technologies has significantly altered the way in which people acquire the knowledge and skills they need to do their jobs. One learning technology concept in particular, the Learning Object (LO), has the potential to revolutionize the paradigm of learning. A Learning Object is a self-standing, discrete piece of instructional content that meets a learning objective.

In the old paradigm, learning was organized into lessons and courses that met specific pre-defined learning objectives. In the new paradigm, content for learning is broken down into much smaller, self-contained pieces of informational content that can be used alone or can be dynamically assembled into Learning Objects to meet the "just enough" and "just-in-time" requirements of a learner.

Analogies for Understanding: Starting with LEGO™

The analogy of LEGO™ blocks is often used when first introducing this new paradigm of modular content and Learning Objects, with the individual Lego pieces representing the smallest piece of raw content (e.g, text, graphics, audio, video).



Raw objects can be used for different types of assets. For example, a photo could be used on a presentation screen but it could also be used in a multiple choice question.

These assets can be snapped together and pulled apart as needed, enabling almost infinite flexibility to create logical assemblies of individual content objects to meet the learning needs of individuals. The assets begin to take on properties and functionality and are then ready to be assembled into Learning Objects. In the SCORM standard, these content objects are referred to a Sharable Content Objects or SCOs.

From LEGO to Buildings: In search of a more powerful analogy for the object approach

While useful in its simplicity, the Lego™ example, often used to describe the modular or object-based approach, is sometimes too simple and limited. It belies the much richer and complex nature of the overall content model needed to show the relationships between content elements of varying complexity. The construction industry may provide a much more robust analogy. On average, 85-

95 percent of all materials in every building built in the past ten years, commercial and residential, are pre-built components. Things like doors, windows, cupboards, sinks, ceiling tiles, and light fixtures are all manufactured to meet specific standard dimensions and attributes. This means that almost all of the material in any building is pre-manufactured and sitting in a warehouse awaiting delivery *before* the building is conceptualized, designed, or built. In many respects, creating a new building is really a complex assembly project.

Although almost all the materials are pre-existing standard-based components, the process of conceptualizing and designing a structure offers tremendous opportunities for creativity and innovation, resulting in unique new buildings. These same component "building objects" can also create dull, uninspired, "cookie-cutter" housing or office buildings. This underscores the importance of architects, designers, engineers, plumbers, electricians, artists, craftspeople, and customers. Objects, like building components, enable enormous creativity. However, their effective use demands careful conceptualization, specification, selection, and assembly.

The more one considers the comparison between the building industry and the emerging content object economy, the parallels become more apparent. For example, standards such as building codes are necessary to ensure a minimal level of safety, functionality, and quality. Standards determine that electrical outlets in bathrooms or other wet places minimize the likelihood of accidental electrocution. It is quite clear that strict enforcement of building codes has little or no effect on the overall conceptual design of buildings. Conforming to standards does *not* mean that there will be nothing but standard buildings that all look the same. Similarly, having a great and ready supply of components does *not* produce products or results. Having all components conform to standards so they are fully interoperable or exchangeable does not mean that they magically can or will assemble themselves.

This component-oriented, object-based model provides the conceptual framework for creating economies of scale. It is largely because of the shift to component-based building construction that: occupying a home does not require having to build it oneself; we can have the volume of buildings we do; they can be constructed quickly, and; they are as affordable as they are. A similar picture for content is emerging: an object-based paradigm, supporting standards, supply chains of specialized components and professions, project based models, and so on. While there is certainly still a great deal of room for improvement within all of these points, the path ahead for content bears remarkable resemblance to the building industry. By using this familiar and relatively mature model as a reference, we can learn from it and accelerate the time it takes for the content equivalent of this model to be created, implemented, and improved.

Just as we have seen the approach to buildings evolve from a craft-based approach to its current highly component-based model, we will see the overall approach to content go through a similar revolution, and in a much shorter time. We will see whole new networks and channels of suppliers and specialty trades emerge as businesses in themselves. The equivalent of door, window, and lighting manufacturers and the complete collection of diverse “trades” of skilled workers will grow and evolve.

Learning Objects: A Conceptual Content Model

Establishing a common understanding and definition of Learning Objects has been a challenge. There are many definitions of Learning Objects, some of which you will see later in the case studies in this section. A common definition, used by many, describes a Learning Object as the smallest piece of instructionally sound stand-alone content. In this case, the Learning Object contains all the elements to cover a single learning objective, i.e., the objective, an introduction, the informational content to meet the objective, a summary, and, finally, an assessment.

However the best understanding of Learning Objects is when they are viewed within the context of an overall conceptual content object model that is based on a hierarchy of granular content. Within a series of levels of granular content, very small raw content assets (individual fact, principle, concept, example, procedure, etc.) can be assembled into a “just right” Learning Object. Each content asset is selected and assembled to match the unique needs of each person and situation, then presented just the right way, in just the right medium, at just the right time.

Content Object Model Characteristics:

- a common component based approach
- structured content based on a common hierarchical data model
- metadata at each level of the content hierarchy
- a process methodology and
- a technical infrastructure for developing, assembling and managing re-usable granular content objects that are written independent of delivery media and accessed dynamically through a database.

The end result is database-managed repositories of re-usable information objects and metadata that can be used for all forms of learning and media delivery types. These include e-Learning, traditional instructor-led training, or blended learning solutions and media delivery types such as print, interactive CDs and Web venues.

More than “just” learning content

It is worth noting that this same common content model is now being applied across many other content domains including, though not limited to, such areas as product support, technical publications, marketing, and localization. In some leading organizations this is being encapsulated as an enterprise wide “community of practice” and the development of an evolving corporate content strategy. Even more powerfully, this truly “enterprise wide” model extends all the way from employees through partners and channels such as re-sellers, training centers, consultants, developers and most importantly to customers.

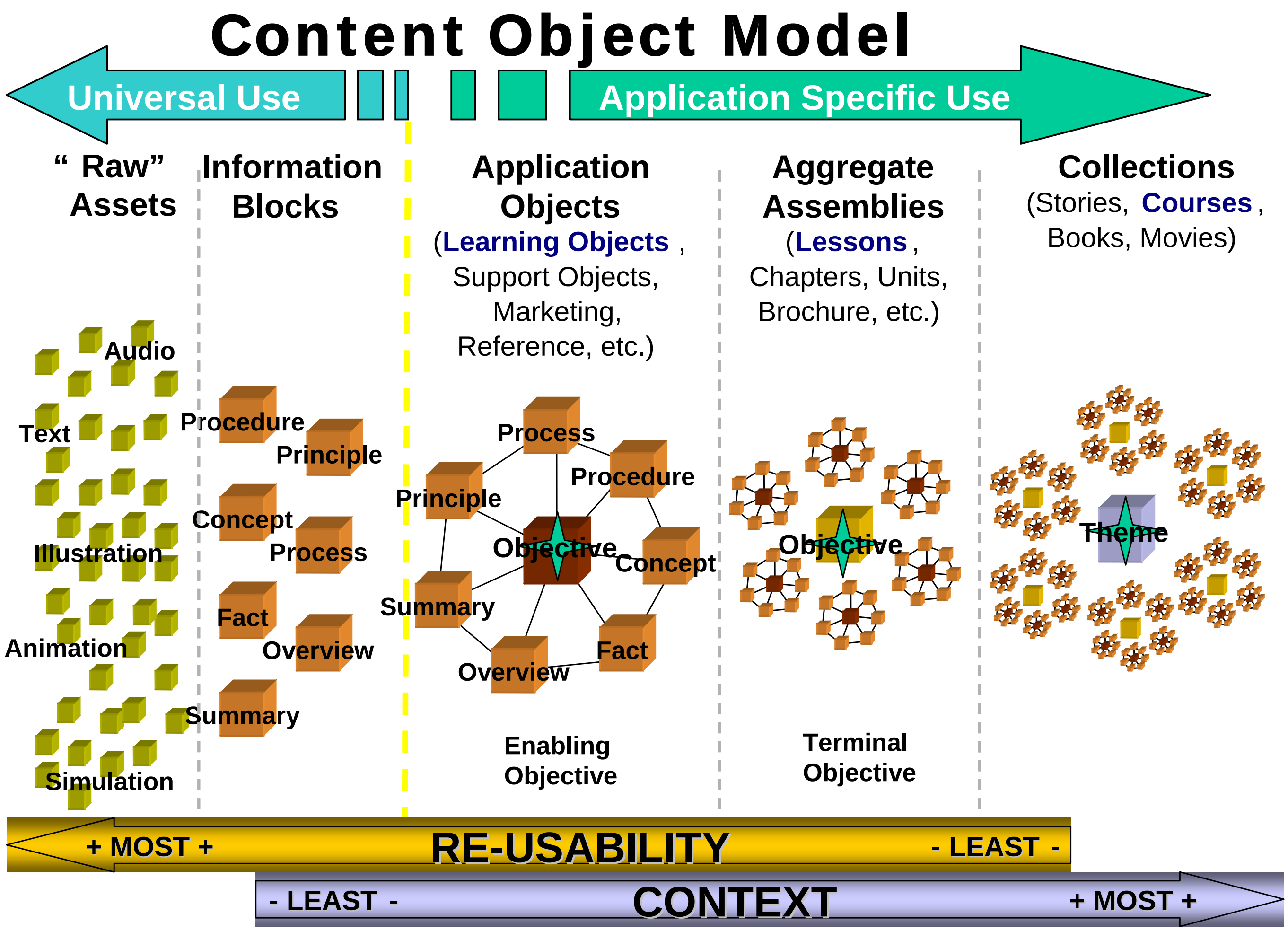
Context + Re-usability are NOT Mutually Exclusive!

It is particularly critical to note how this model delivers both a high degree of re-usability *and* a high degree of context. Context and re-usability are extremely valuable; context being literally required and directly proportional to the effectiveness of the content for learning and re-usability being directly related to the return on investment in content. However these are typically seen as being mutually exclusive.

By themselves, there is little to no context in the raw content elements of information blocks as they are extremely small and devoid of any specific application. Context is provided by the design within which the small information blocks are assembled and the situation within which they are used. Thus, the previous dichotomy between re-usability and context is resolved.

The flexibility of the Learning Object content model is in the ability to store, locate, and repurpose content as needed. Since Learning Objects themselves are rather large and contain a great deal of context, flexibility lies more in the ability to *create* a Learning Object by assembling a collection of just the right small pieces of raw content. Learning Objects and their asset items are "tagged" with metadata, allowing them to be easily located and assembled into more meaningful context. As the content gets smaller and lower in the content object model hierarchy, it becomes much more re-usable as it has less context. Similarly, as the smaller content assets are selected and placed into purposefully designed larger units as Learning Objects, they gain the context required for learning and lose their re-usability.

This overall content object model and the inverse relationship between context and re-usability are illustrated in diagram that follows.



Multi-Level Content Model Taxonomy

Note that this generic hierarchy applies to multiple applications and that the first two levels are the same for all (enterprise-wide) and then become specific to "application profiles" such as learning, for the levels thereafter, as they move to the right.

While there can be any number of levels in this Content Object Model, the four main levels are as follows:

- Data or Raw Media Elements are the smallest level in this model and consist of the "raw media" stored at a pure data level. Examples include a single sentence or paragraph, single illustration, animation, video, audio clip, etc.
- The second level of Information Objects is formed by a set of these data elements to create a granular, re-usable chunk of information that is media independent. These could be based on the well defined and proven "information block" model as developed by Dr. Robert Horn. [http://www.stanford.edu/~rhorn]
    - Dr. Horn uses text and illustrations in this original (mid 1960's) research and development of this classification model, however it would apply equally well for any type of "information object."
- Based on a single (enabling) objective, Information Objects are then selected and assembled into the third level of Application Specific Objects. This is the level in the hierarchy for one of the most common types in use today, the Learning Object (LO).
- The fourth and fifth levels are defined around the larger (terminal) objectives to create Aggregate Assemblies such as lessons or chapters, which can in turn be assembled into ever larger Collections which might be such things as courses and whole curricula.

Mass Customization of Learning Content

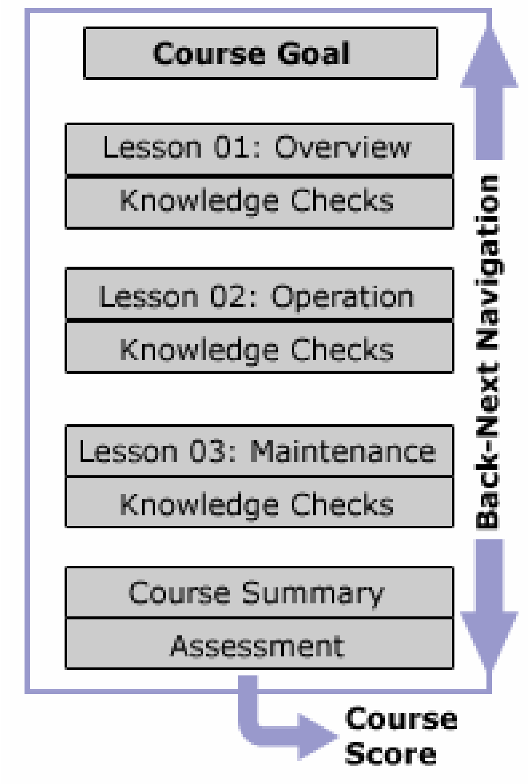
When this comprehensive content object model is put into operation and applied to learning, the power of the inherent flexibility and re-usability of the model becomes clear. Once developed, this great mass of digital assets can be stored within a database-managed repository. With the aid of metadata to detail and describe their attributes, each is ready to be used and re-used through mass customization of assembly within multiple contexts and applications, and delivered within multiple delivery mediums, formats and devices.

This model is applicable to most types of content applications and delivery, however the most common use is for computer managed Learning Objects which are delivered electronically via the Web or physical mediums such as CD, DVD, or paper.

Traditional e-Learning vs. Learning Object Model

To help explain this further, let's look at a traditional model of an e-Learning course compared to the Learning Object approach.

Traditional Course / Lesson / Assessment Model

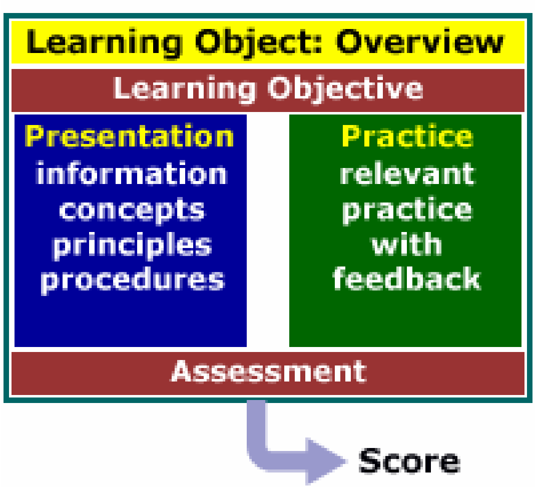


In this traditional model of an e-Learning course, the course is developed as a single unit of instruction. It is a complete presentation of all the materials required to meet the defined course goal.

Each lesson is normally a set of screens with information presented in the form of text, images, pop-ups, roll-overs, and maybe even audio and video files. Each lesson usually ends with a set of knowledge checks which would consist of multiple choice questions, drag-n-drop interactions, and other traditional quiz interactions.

The lessons are contained in a shell that includes navigation. Navigation of the lessons is normally a combination of back/next buttons and a course menu.

The course ends with a series of summary statements followed by a test that is normally a multiple-choice test. The course is a complete unit with a single score that would be recorded to a database or Learning Management System.



Now let's take a look at a slightly different way to organize the same information in the previous example.

Consider the information from the first Lesson 01: Overview. Begin by defining a measurable learning objective. Next define an appropriate assessment to measure the competency of the learning objective. Now you are ready to fill the Learning Object (SCO) with the assets required to meet the learning objective.

The two major differences between this method of development and the former are that each Learning Object has its own assessment and navigation. For example, an overview Learning Object might use a traditional Back-Next navigation of conceptual information. A maintenance Learning Object might show an image of a machine or system on a single screen and the user navigates from links on the machine to access demonstrations, practice, and assessment. A Learning Object intended to teach the student how to use a software application might have an interactive demonstration of the software application with testing and scoring all contained in a single file embedded on a single Web page.

Each Learning Object is a stand-alone instructional unit. Everything that is required to teach a task, skill, or concept and measure competency is included in the Learning Object. In addition, each asset within the Learning Object is also re-usable and has its own metadata, enabling it to be searched in a content management database.

Every Learning Object has a Personality

The Learning Object will have its own personality. It will have unique properties or attributes such as subject matter, industry, and type of instruction or possibly even the intended audience. We refer to these properties as metadata. (See *Section 3* for more on metadata). They are key words that associate the Learning Object with its instructional purpose. Let's look at an example.

Property Name	Metadata
industry	plastics
intended audience	maintenance, technicians
type of instruction	procedural, troubleshooting
subject matter	extruders

Benefits and Risks/Obstacles

As we all know, there are benefits and risks (or obstacles) in most everything we do. Adapting a Learning Object approach to content development and management is no exception. Also, because we are still early in this paradigm shift, we still do not know the full extent of how Learning Objects will affect how we work and learn. However, experts in the field do expect the following benefits and risks as a minimum.

Benefits of Learning Objects		
For Learners	**For Administrators**	**For Developers**
Personalized courses can be constructed to meet individual requirements.	Courses can be customized to suit the needs of different audiences.	Objects can be built or modified using many different authoring tools.
Learning comes in digestible chunks.	Courses can be constructed using components from a wide range of sources.	The same objects can be employed across a variety of hardware and software platforms.
Learning is available on a just-in-time basis.	Components can be re-used to meet a range of learning needs.	Learning Objects and assets can be stored in a Content Management System so that the developer can search for them and repurpose them.

This table was adapted from "Objects of Interest" created by Clive Shepherd of Fastrak Consulting Ltd. in 2000.

Risks of Learning Objects		
For Learners	**For Administrators**	**For Developers**
Learners will require self-motivation to select Learning Objects. The implementation of Learning Objects will require a paradigm shift in the way learners view education. Education and training are traditionally viewed as events which we refer to as training courses.	Administrators will see this as more work to organize Learning Objects into courses and training programs. When administrators try to link several Learning Objects together to make a training course or program, he/she may find that the navigation of each Learning Object is unique.	Developers will need to build many small objects as opposed to a few larger courses. This will be perceived as counter-productive because of the additional work in development as well as design. A manager or content owner requesting a course on a program or process may not want to break the materials into small Learning Objects that stand alone and are labeled with “assembly required.” If a developer wanted to repurpose a Learning Object from another developer, he/she would need to have the original development tool.

SCORM Content Aggregation Model

The following set of standards and guidelines relating to structure are based on the SCORM (Sharable Content Object Reference Model) Content Aggregation Model, as it is outlined in SCORM version 1.2 and 1.3 (available at http://www.adlnet.org).

The SCORM Content Aggregation Model defines how learning content can be identified and described to facilitate discoverability and re-use. This model also defines how Learning Objects can be assembled from smaller information blocks and raw assets such as single illustrations, animations, blocks of text or audio and then subsequently how these Learning Objects can be aggregated into a larger collection such as lessons and courses. The Content Aggregation Model also enables any of these levels to be moved from one Learning Management

System (LMS) to another or between Learning Content Management System (LCMS) repositories. Metadata creation tools are available from SCORM via the http://www.adlnet.org website in the "downloads" section. Additionally, content producers can test their content on the site to confirm compliance.

The SCORM Content Aggregation Model has three primary building blocks: raw content item, Sharable Content Object (SCO), and Content Aggregation Metadata.

Raw content item:
A raw content item is the most atomic form of learning content. Raw content items are electronic representations of text, images, sound, Web pages, etc. All raw content items produced for DCA will follow the SCORM IEEE Standards (Institute of Electronics and Electronics Engineers). These standards can be located at http://www.adlnet.org.

Sharable Content Object (SCO)
A SCO represents a collection of one or more raw content items, representing the lowest level of granularity of content that an LMS is able to track.

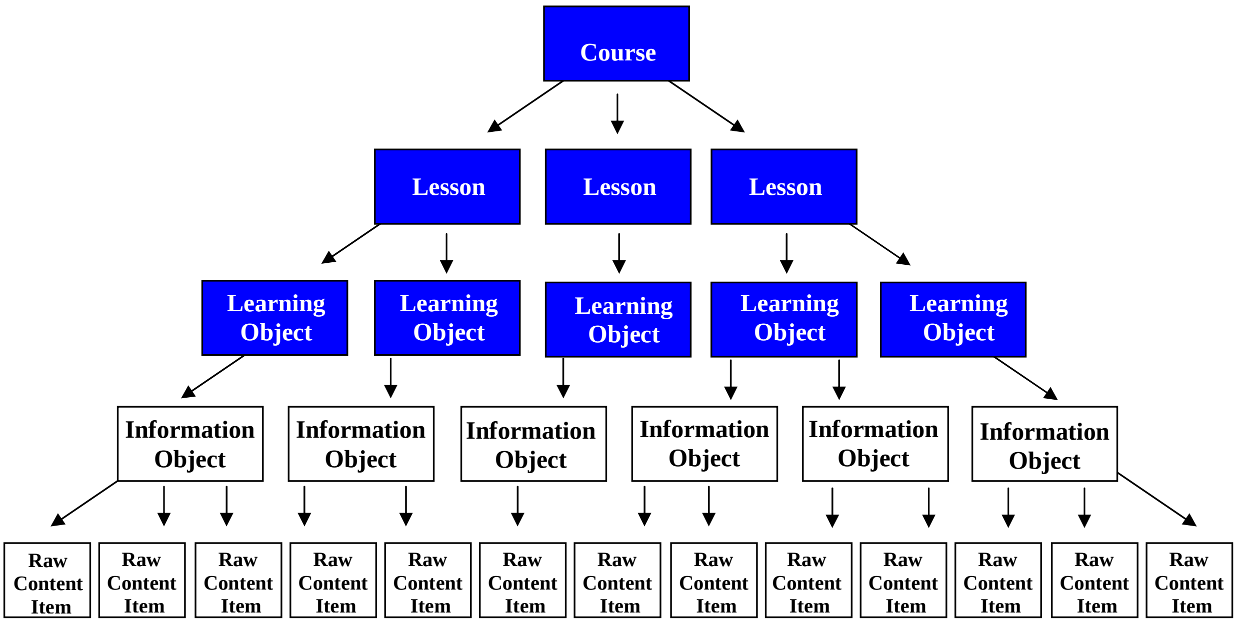
Content Aggregation Metadata (Block):
A hierarchal representation of SCOs and/or other elements, aggregated to form higher-level units of instruction.

Case Studies

Case Study #1 DaimlerChrysler Academy (DCA)

Content Aggregation Model Use Case

This case study provides a better understanding of how the Content Aggregation Model works in practice, the following example is provided courtesy of the DaimlerChrysler Academy (DCA).



The elements of the SCORM Content Aggregation Model map to the elements of a DCA standards-based course as indicated in the table below:

DCA Course Element	Description	SCORM Element
Raw content item	Graphic, audio file, video file, Web page, flash file, etc	Raw content item
Learning object	Several information objects grouped together	Content Aggregation Metadata
Lesson	Several Learning Objects grouped together	Content Aggregation Metadata
Course	A group of lessons	Content Aggregation Metadata

DCA Implementation Policies

The following are samples of implementation policies created by DCA. They illustrate the type of decisions an organization needs to make and the guidance it needs to have for the effective use of SCORM. It will be up to each organization or community of practice to determine how strictly these will be applied (guidelines vs. policy requirements) and how detailed or general they will be.

- SCOs must conform to SCORM 1.2 specifications, including all relevant SCORM metadata standards.
- The metadata document for a course, lesson, or Learning Object must at least include the mandatory metadata elements for content, as defined in SCORM version 1.2. Content aggregates must be SCORM 1.2 standards compliant.
- SCOs are designed to be subjectively small. When designing SCOs, designers should give some thought to the smallest logical size of the content that one might desire to have tracked by a LMS at run-time.
- How a course is partitioned into lessons, Learning Objects, and information objects is a designer's decision. However, when making these decisions, designers should consider the potential re-use of each of the aggregations.
- Designers of SCOs should take into consideration the different learning contexts in which SCO might be included.
- Courses will contain either one or more lessons, or one or more learning Objects.
- Lessons, if used, will contain either one or more Learning Objects, or one or more information objects.
- Learning Objects, if used, will contain one or more information objects.

Case Study #2: Corporation XYZ, Industrial Regulation

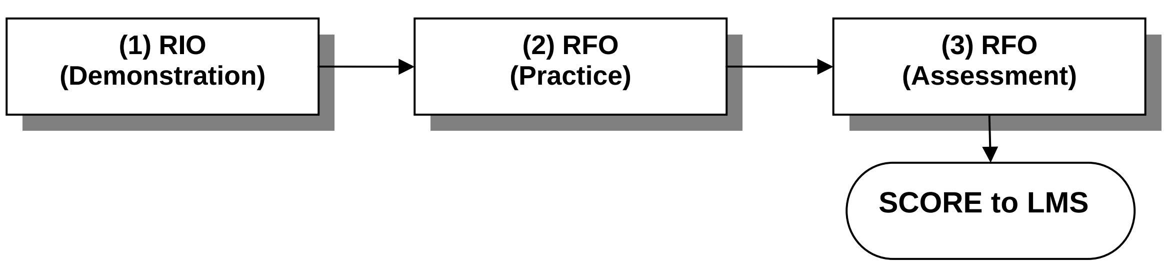
Problem Statement: All departments in a division of the corporation XYZ are required to follow an industrial regulation. Training is required to ensure that people are able to identify when a process or a function within a software application violates the regulation and to then determine a remediation. Currently an instructor-led course is given by the subject matter expert who is also an auditor of departmental processes and or systems. The subject matter expert currently needs to design a customized presentation for every department in order to ensure that the training is relevant to specific departmental applications, systems, or processes.

Solution: The solution was to develop a Re-usable Learning Object (RLO) that could be used for different departmental case studies or problem solving scenarios. The RLO consists of two assets, one Re-usable Information Object (RIO), and 2 Re-usable Feedback Objects (RFO).

(1) The student is first presented with a case study (text, images, and possibly audio). The RIO will present the process for properly asking questions in the correct sequence to arrive at a final decision point. The department or individual must determine if the process, application, or practice: (a) is in the scope of the regulation, (b) if it is in the scope, does it meet the requirements or (c) is it in violation of the regulation. A summary will be presented on the correct remediation. Some very low level T/F questions will be asked at an informational recall level or the lower Blooms taxonomy levels.

(2) In the second component of the Learning Object a practice RFO will be presented. The second component of the instruction will present a new instance of the case study. The process for conducting an audit will now be practiced by the student. The student will be asked to select the correct path of queries to arrive at the proper conclusion. This will allow for activities at the analysis level of Bloom's taxonomy. This RFO will not be tracked or scored.

(3) The third component of the instruction will present a third case study. The student will go through the same process as the practice component but in this instance, the student's performance will be tracked and a single score will be generated.



Re-usability: Once the Learning Object is built, (navigational framework, presentation objects, feedback interaction objects), the content or the case studies can then be inserted into the objects. When a new case study is developed, we will simply change the text in the course and have a new instance of the Learning Object. All of the instances of the Learning Objects will have the same navigation, presentation, and feedback functionality but the content will be different.

Case Study #3: Bristol-Myers Squibb

Learning Object Definition

The Term Re-usable Learning Object (RLO) is used by our organization to align our terminology with our Enterprise Management System. In our model, the smallest trackable unit of instruction is the Learning Object within a Component. By matching our terminology, we clarified how the learning module would be used in the context of our technology.

The RLO is *required* to consist of the following:

- One terminal objective, supported by 3 to 7 enabling objectives
- Content aligned to each enabling objective
- Check-on Learning assessments aligned to each enabling objective

The RLO is recommended to consist of the following:

- A duration of 15-20 minutes per module (courses may be made up of as many modules as necessary)
- No context that would limit its use by other groups within the company
- A solid framework for an instructional lesson for each enabling objective in a presentation, demonstration, learner application, evaluation model.
- Interactions and instruction that are as closely representative of job-based application as possible.
- Animation and audio narration throughout, and eliminate or limit the need to read paragraphs of text on screen.

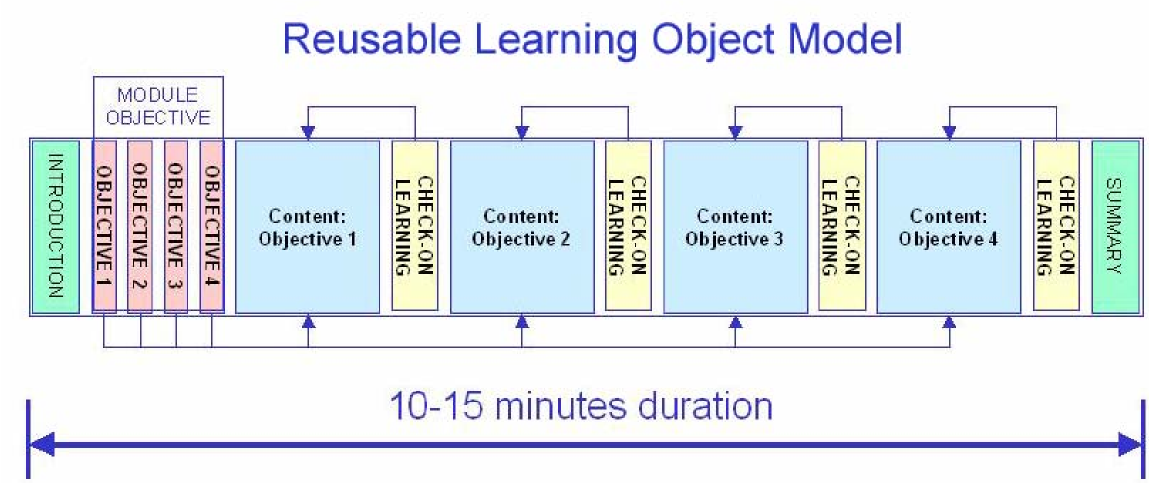
Challenge

The greatest challenge to implementing an object-based or modular approach to online learning was making the format easy to communicate to other organizations and vendors who had little formal training in e-Learning development and whose main concern was whether or not the format could be implemented successfully. When looking at many existing RLO formats, it became clear that they had accepted a greater administrative burden than our organization would support. The smaller the object, the more difficult to reconstruct new courses and the more objects requiring tagging with metadata. We could sacrifice the agility of a more flexible system for the reliability that comes with simplicity.

Our other major challenge was that we could not impose too many “instructional design” constraints, acknowledging that many of our organization’s online training efforts consisted of the information briefing type where the concern was to track attendance. We did not want to alienate anyone by becoming instructional elitists, knowing that we could have greater influence for improving overall instructional design in the organization by taking a big tent approach. A freedom to choose instructional content by the content owner was necessary, or we could not gain buy-in.

Solution

Our solution to the challenges outlined above is simple as illustrated below. Any member of any one of our learning organizations can apply this model to one of their programs and implement this through our LMS.



Every aspect of the RLO model allows for variation in how the designer chooses to implement. In some instances a person may simply take a written document and backward engineer learning objectives and check-in questions to complete the model. In more desirable situations, one of our instructional designers will create an engaging introduction that leads into specific and measurable learning objectives which are achieved through engaging instructional content and relevant check-on learning exercises, producing measurable job-related knowledge and skill training.

Benefits

The RLO model provides many benefits for our organization. It provides enough instructional format, using the learning objective - content – assessment model to steer us away from too much information push. It also creates Learning Objects that are large enough to be re-used by members of our organization who may be discouraged from the amount of work required to construct new courses out of Learning Objects at an enabling objective level.

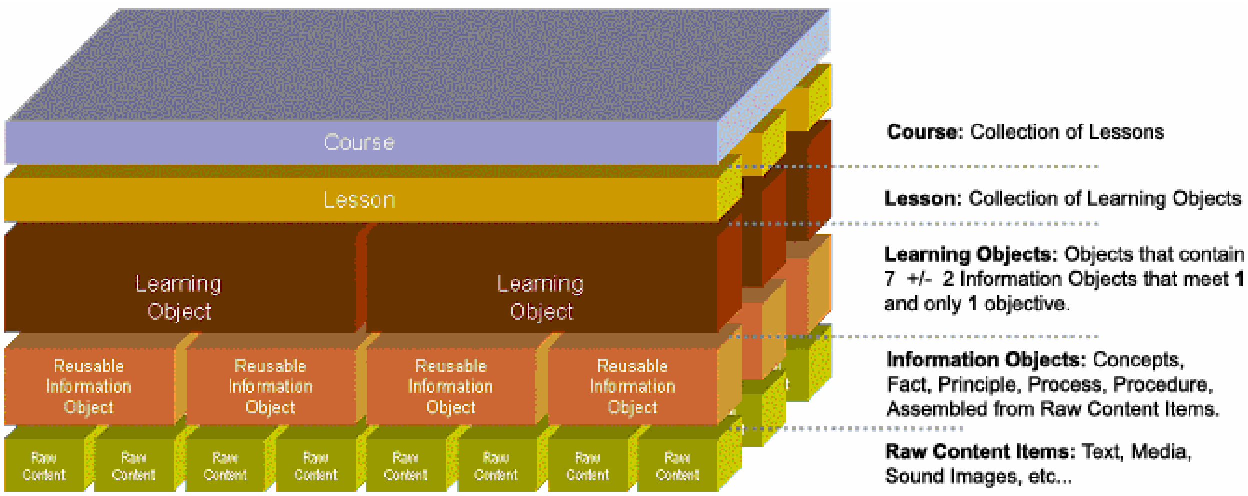
We also benefit from the flexibility of the RLO. In our current business climate, speed matters, but at the same time we must carefully choose when and where to apply our efforts. The RLO can scale for any e-Learning project, from SOP training, to a business process course containing guided discovery exercises, and it is that resilience that makes it an effective model for our current e-Learning environment.

Currently we have successfully implemented our RLO strategy in the development of sales training, regulatory training, and internal process overviews. The focus of all of these is on knowledge development. As we become more adept at applying this model, and identify vendors who can work successfully within this model, we clearly expect that an increasing amount of our knowledge development training will be successfully moved online, as well as computer skills training. This will allow us to focus on skill development in the classroom-based components of our blended learning model, using both modalities in ways that maximize their effectiveness.

Case Study #4: Autodesk Inc. Learning Content Object Model

Autodesk uses the content Object Model as the basis for Learning Objects and as outlined previously in this document. The following will provide more details of how this modular approach to a learning content object model is implemented and applied in practice.

Autodesk Learning Object Content Model:

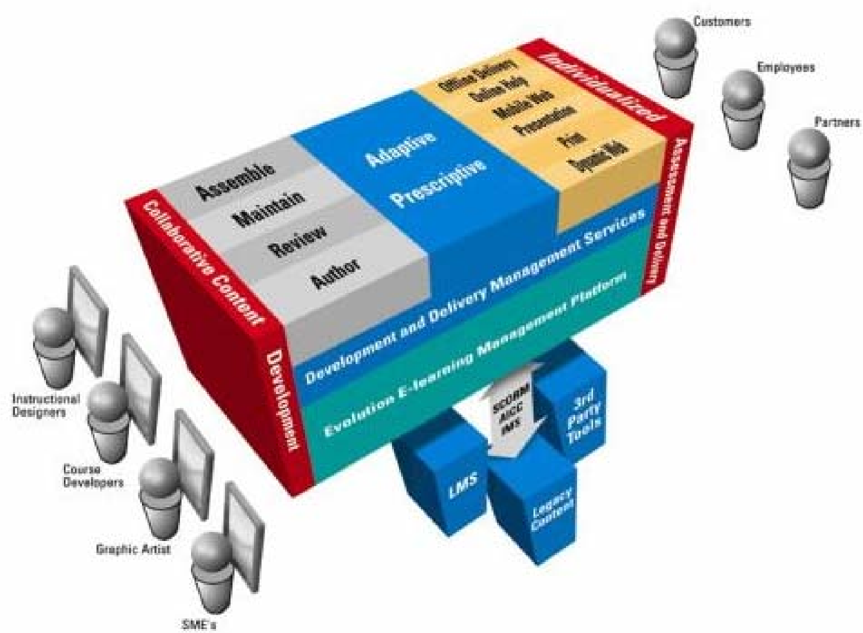


autodesk Learning Object Content Model

Mass Customization of Learning Experiences

Intelligent Delivery

Given the extreme scope and size of the Autodesk "virtual enterprise" (20 million users, developers, dealers, partners and employees) and our vision of delivering personalized and performance improving learning, it is critical that we are able to deliver all learning content in the format most appropriate for this diverse audience.



Personalized Experience

Utilizing our LCMS intelligent delivery means we can increasingly and automatically tailor learning content for different audiences. Content can be adapted to suit a specific learner's profile, role or other stated preference. This personalized experience incorporates both the content itself as well as the navigation paradigm.

This not only enables the intelligent delivery of targeted learning content, but it can also deliver that content with a look and navigation paradigm specifically suited to the intended audience. Autodesk channel partners, for example, may experience a very different look and feel than customers. This has proven to be so successful in delivering customized content for customers that we are now offering this as a service and content business Content Strategy.

Flexible, Dynamic Delivery

To accommodate our enterprise wide and blended learning strategy, we are increasingly able to implement the dynamic and flexible delivery of content. The Autodesk methodology and technology for creating content (text, illustrations, animations, simulations, etc.) is combined with our modular-based content strategy and repositories. This combination means that without any additional development work, our learning content can be delivered in the formats that include:

- Online Autodesk Virtual Classroom Training (AVTC) courses via the Internet or Intranet
- Microsoft Word, Frame, PDF and other print documents, formatted with table of contents, chapter breaks, and appendices
- Microsoft PowerPoint slides
- CD-ROMs
- Downloadable bundles for offline viewing
- PDA devices
- SCORM - all content can be packaged in accordance with SCORM standards for easy transferability.

Comprehensive Content Strategy

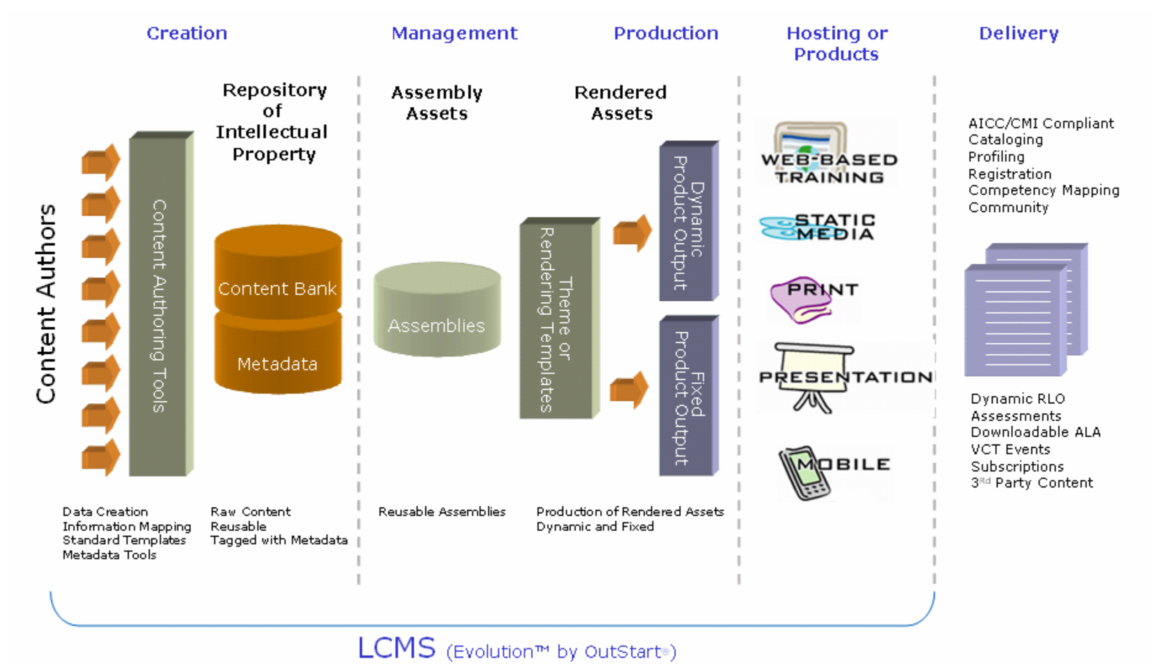
The end result is database-managed repositories of re-usable information objects and metadata that can be used for all forms of learning and media delivery types. These include e-Learning, traditional instructor-led training, or blended learning solutions and media delivery types such as print, interactive CDs and Web venues. It is worth noting that this same common content model is now being applied across many other content domains, including, though not limited to, such areas as product support, technical publications, marketing, and localization. At Autodesk Inc., this is being encapsulated as an enterprise wide “community of practice” and the development of an evolving corporate content strategy. Even more powerfully, this truly “enterprise wide” model extends all the way from employees through partners and channels such as re-sellers, training centers, consultants developers and most importantly to the millions of Autodesk customers.

Mass Contribution: Mass Customization

With all the content in standards-based "federated" repositories managed by our LCMS, we are able to have a "virtual single source" of content that has come from a large number of content contributors, including product documentation, Help files, product support, training, external publishers, instructors and even the customers in some cases. With this "federated" set of repositories, instructors are able to create a customized learning experience "on demand" by assembling a combination of text, slides, exercises, assessments and simulations to match their topics and students. Furthermore, the content itself is designed for additional "mass customization." For example, by integrating our simulation content created with our virtual classroom tool, we are able to provide a unique learning experience for each student because they are able to work through a simulation that interacts with them in real time and adapts to their speed, success and abilities. All the while the instructor is able to manage these experiences by watching any student's progress, intervening as appropriate, taking control for the group, etc.

Content Infrastructure

The diagram below provides more details on the content infrastructure to support and implement the Autodesk learning and content strategy.



autodesk Content Infrastructure

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Into the Future, by Wayne Hodgins [http://www.learnativity.org/into_the_future2000.html].

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eLearning Roadmap: [http://www.masie.com/standards/s3supplement/RM03.pdf].

SCORM for Instructional Designers (and other guidelines) Carnegie Mellon University, Learning Systems Architecture Lab [http://www.lsal.cmu.edu].

Appendix 1: Standards and Specifications Groups

Purpose

This appendix cites the primary groups and organizations responsible for developing standards along with their URL links for further reference.

Standards and Specifications Groups

ADL Initiative: (Advanced Distributed Learning)

An initiative by the U.S. Department of Defense and its partners in industry, academia, and the private and federal sectors to achieve interoperability across computer and Internet-based learning courseware through the development of a common technical framework, which contains content in the form of re-usable learning objects. This group is responsible for authoring the SCORM document. [http://www.adlnet.org]

From the ADL Website: The purpose of the ADL initiative is to ensure access to high-quality education and training materials that can be tailored to individual learner needs and made available whenever and wherever they are required. This initiative is designed to accelerate large-scale development of dynamic and cost-effective learning software and to stimulate an efficient market for these products in order to meet the education and training needs of the military and the nation's workforce of the future. It will do this through the development of a common technical framework for computer and net-based learning that will foster the creation of re-usable learning content as "instructional objects."

AICC (Aviation Industry Computer-Based Training Committee):

An international association of technology-based training professionals that develops training guidelines for the aviation industry. AICC is developing standards for interoperability of computer-based and computer-managed training products across multiple industries. [http://www.aicc.org]

From the AICC Website: The AICC's mission is to provide and promote information, guidelines and standards that result in the cost-effective implementation of CBT and WBT.

ALIC (Advanced Learning Infrastructure Consortium) (Japan):

From the ALIC Website: Our objective is to establish an active society by reasonably and effectively providing a learning environment, which enables anyone to learn anytime, anywhere, according to the goals, pace, interests and understanding of individuals and groups. Also, we attempt to foster experts who will be the origin of global competitiveness. [http://www.alic.gr.jp/eng/index.htm]

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

From the ARIADNE Website: ARIADNE is a research and technology development project pertaining to the "Telematics for Education and Training" R&D program sponsored by the European Union. The project focuses on the development of tools and methodologies for producing, managing, and re-using computer-based pedagogical elements and telematics-supported training curricula. Validation of the project's concepts is currently taking place in various academic and corporate sites across Europe. [http://www.ariadne-eu.org/]

CANCORE (Canadian Core Learning Resource Metadata Application Profile)

From the CanCore Website: This site is the official home for documents, presentations and other resources related to the Canadian Core Learning Object Metadata Application Profile. The CanCore Profile is intended to facilitate the interchange of records describing educational resources and the discovery of these resources both in Canada and beyond its borders. CanCore is based on and fully compatible with the IEEE Learning Object Metadata standard and the IMS Learning Resource Metadata specification. [http://www.cancore.ca/indexen.html]

CEN/ISSS (European Committee for Standardization/Information Society Standardization System):

From the CEN/ISSS Website: The mission of CEN/ISSS is to provide market players with a comprehensive and integrated range of standardization-oriented services and products, in order to contribute to the success of the Information Society in Europe. [http://www.cenorm.be/isss]

CETIS (The Centre for Educational Technology Interoperability Standards):

CETIS is a UK-based and government funded group that focuses on interoperability of learning technology standards.

From the CETIS Website: CETIS represents UK higher-education and further-education institutions on international learning technology standards initiatives. [http://www.cetis.ac.uk]

DCMI (Dublin Core Metadata Initiative):

From the DCMI Website: The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable metadata standards that support a broad range of purposes and business models. DCMI is dedicated to promoting the widespread adoption of these standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices. [http://dublincore.org/]

EDNA (Education Network Australia):

From the EdNA Website: EdNA Online is a service that aims to support and promote the benefits of the Internet for learning, education, and training in Australia. It is organised around Australian curriculum, its tools are free to Australian educators, and it is funded by the bodies responsible for education provision in Australia - all Australian governments. [http://www.edna.edu.au/edna/page1.html]

GEM (Gateway to Educational Materials):

From the GEM Website: The Gateway to Educational Materials^{SM} is a Consortium effort to provide educators with quick and easy access to thousands of educational resources found on various federal, state, university, non-profit, and commercial Internet sites. GEM is sponsored by the U.S. Department of Education and is a special project of the ERIC Clearinghouse on Information & Technology. Teachers, parents, administrators can search or browse The Gateway and find thousands of high quality educational materials, including lesson plans, activities, and projects from over 414 GEM Consortium member sites. [http://thegateway.org]

IEEE (Institute of Electrical and Electronics Engineers):

The IEEE has more than 380,000 members in approximately 150 countries. Through its members, the organization is a leading authority on areas ranging from aerospace, computers and telecommunications to biomedicine, electric power and consumer electronics. The IEEE produces nearly 30 percent of the world's literature in electrical and electronics engineering and in computer science. This nonprofit organization also sponsors or cosponsors more than 300 technical conferences each year. Additional information about the IEEE can be found at http://www.ieee.org

The IEEE Standards Association, a globally recognized standards-setting body, develops consensus standards through an open process that brings diverse parts of an industry together. These standards set specifications and procedures based on current scientific consensus. The IEEE-SA has a portfolio of more than 870 completed standards and more than 400 standards in development. Over 15,000 IEEE members worldwide belong to IEEE-SA and voluntarily participate in standards activities. For further information on IEEE-SA see http://standards.ieee.org.

LTSC: Learning Technology Standards Committee

The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology.

The LTSC coordinates formally and informally with other organizations that produce specifications and standards for similar purposes. Standards development is done in working groups via a combination of face-to-face meetings, teleconferences, and exchanges on discussion groups.
For information on LTSC visit http://ltsc.ieee.org.

LTSC Working Groups:

The mission of IEEE LTSC working groups is to develop technical Standards, Recommended Practices, and Guides for software components, tools, technologies, and design methods that facilitate the development, deployment, maintenance, and interoperation of computer implementations of education and training components and systems.
For a full listing of all the LTSC Working and Study Groups, see http://ltsc.ieee.org.

Some relevant examples include:

Working Group 1: Learning Technology Systems Architecture

This Standard specifies a high level architecture for information technology-supported learning, education, and training systems that describes the high-level system design and the components of these systems. This Standard covers a wide range of systems, commonly known as learning technology, education and training technology, computer-based training, computer assisted instruction, intelligent tutoring, metadata, etc. This Standard is pedagogically neutral, content-neutral, culturally neutral, and platform-neutral. This Standard (1) provides a framework for understanding existing and future systems, (2) promotes interoperability and portability by identifying critical system interfaces, and (3) incorporates a technical horizon (applicability) of at least 5-10 years while remaining adaptable to new technologies and learning technology systems. This Standard is neither prescriptive nor exclusive.

Working Group 11: Computer Managed Instruction

Today Computer Based Training (CBT) is being written by a diverse number of parties using very diverse tools or authoring systems. Many of the CBT lessons being developed can complement and work well with other lessons developed in different locations with different tools by different people. There is a need to allow these complementary lessons to be brought together and used in a single course. However, this cannot be done without defining a standard set of CMI (Computer Managed Instruction) functions and a matching set of CBT functions.
[http://ltsc.ieee.org/wg11/index.html]

Working Group 12: LOM 1484.12 Learning Object Metadata

LOM is now a fully develop standard defined by IEEE. This standard specifies the syntax and semantics of Learning Object Metadata, defined as the attributes required to fully/adequately describe a Learning Object.
[http://ltsc.ieee.org/wg12)]

IMS Global Learning Consortium (Instructional Management System):

IMS is a global consortium with members from educational, commercial, and government organizations dedicated to defining and distributing open architecture interoperability specifications for e-Learning products.

From the IMS Website: IMS Global Learning Consortium, Inc. (IMS) is developing and promoting open specifications for facilitating online distributed learning activities such as locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems.

IMS has two key goals:
1. Defining the technical specifications for interoperability of applications and services in distributed learning, and
2. Supporting the incorporation of the IMS specifications into products and services worldwide. IMS endeavors to promote the widespread adoption of specifications that will allow distributed learning environments and content from multiple authors to work together (in technical parlance, "interoperate"). [http://www.imsproject.org]

IMS Question-Test Interoperability (QTI) Specification

Assessment is an integral part of learning and therefore warrants an appropriate amount of care and attention when it comes to standards for learning. On the one hand, questions, tests, and other aspects of assessment are the same as any other content and form of learning interactivity. Therefore, they can benefit from the same standards and specifications that are used for any other type. However, there are also some unique aspects of assessment which may require unique treatment.

As with any content used for learning, good test questions take a lot of time and money to produce, and organizations who are computerizing assessments need to be able to make banks (repositories) of questions without being tied to an internal or proprietary vendor format. This increases the ability to use and re-use this content over the long term. It also permits publishers to release material in a single format and have it be deliverable across multiple platforms, to multiple tools and engines. The IMS Question Test Interoperability (QTI) specification address this issue by representing questions and assessments in a platform- and vendor-independent manner, by leveraging the XML programming language. By exporting questions and assessments into QTI XML, users of questions and assessments can put material in a standard format from which other systems can import or use.

Version 1.2 of QTI was released in Feb 2000 and can be seen at http://www.imsproject.org/question. The specification includes sections on questions, assessments (how groups of questions are sequenced as a test), and results. To date, however, the only widespread use of the specification is the section on questions (also called items). Although the specification is supported by several vendors, there are several areas of ambiguity; the standard can be used to exchange simple questions, but different vendors often implement more complex questions in different ways. There are also some important omissions. For example, publishers have complained that they cannot sufficiently use metadata tags to include relevant information with questions they publish. These and other challenges have kept QTI from being included within the current versions of SCORM.

The IMS is currently undertaking a process of updating QTI to version 2. The update focuses only on questions/items (not assessments or results) and aims to resolve the ambiguities, add a few needed features, and also explain how content packaging can be used with QTI. Subject to satisfactory progress within IMS, it is likely that a version 2 of IMS QTI will be available in the summer of 2004.

ISO (International Organization for Standardization):

From the ISO Website: The ISO is a worldwide federation of national standards bodies from some 140 countries, one from each country. ISO is a non-governmental organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. ISO's work results in international agreements which are published as International Standards. [http://www.iso.org]

JISC (The Joint Information Systems Committee):

From the JISC Website: JISC supports further and higher education by providing strategic guidance, advice and opportunities to use Information and Communications Technology (ICT) to support teaching, learning, research and administration. JISC is funded by all the UK post-16 and higher education funding councils. [http://www.jisc.ac.uk]

MARC (Machine-Readable Cataloging):

From the Library of Congress MARC Standards Website: The MARC formats are standards for the representation and communication of bibliographic and related information in machine-readable form. [http://www.loc.gov/marc]

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

From the PROMETEUS Website: 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. PROMETEUS is an expert opinion-making forum where actors from a wide range of professional, cultural, and linguistic backgrounds, come together to build critical mass in the field of educational technology and applications. The complementary expertise of the PROMETEUS Signatories is brought together in the aim to bridging the gap between research and actual use of learning technologies, content, and services. [http://www.prometeus.org.uk]

WS-I (The Web Services Interoperability Organization):

From the WS-I Website: The Web Services Interoperability Organization is an open industry effort chartered to promote Web Services interoperability across platforms, applications, and programming languages. The organization brings together a diverse community of Web services leaders to respond to customer needs by providing guidance, recommended practices, and supporting resources for developing interoperable Web services.

W3C (World Wide Web Consortium):

W3C is a relevant site to the standards implementer because it is the home of many of the technical standards referenced and used within learning technologies such as including HTML, HTTP, XML, URL, and SOAP.

The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and collective understanding. [http://www.w3.org]

Appendix 2: Learning Standards Glossary

Purpose

This appendix serves as a preliminary guide to understanding some of the key terms found when engaging in discussions about e-Learning, standards, and their implementation. Additional resource links are also provided for your reference.

Definitions

Accessibility:

> The ability to locate, access, and deliver the appropriate instructional components to multiple remote locations at the appropriate time via the appropriate device. Also, a characteristic of technology that enables people with disabilities to use it. For example, accessible Websites can be navigated by people with visual, hearing, motor, or cognitive impairments. Accessible design also benefits people with outdated software and hardware. See also *Section 508* in this glossary.

Application Program Interface (API):

> Operating system services made available to programs that run under the operating system. Programming code used by an application to communicate with the operating system or with a database management system and provides function calls that link common procedures or data between two applications.

Asset:

> Learning content in its most basic form such as electronic media, text, images, sound, Web pages, assessment objects, or other pieces of data. An asset can be described with metadata to allow for search and discovery within content repositories, thereby enhancing opportunities for re-use and delivery.

Certification:

> The acknowledgment that testing has been completed and the criteria of a standard or specification has been met. Certification validates a product's conformance for interoperability and re-use. There may also be varying levels of certification for each standard. Certification is to be legally obtained through an approved certifying body authorized to issue the certification.

Compliance or Compliant:

> Many Learning Management System or content vendors today claim "compliance" or say they are "compliant" to a specific learning standard. As a result, these terms are used freely without a real understanding of their meaning, and often used interchangeably. We recommend that conformance be the term used and to avoid the use of compliance or

compliant. This is both for clarity and because "compliant" is an adjective which means "conforming to requirements," so the real issue is the action of the verb conformance, which is most simply "to follow a standard." For more information about compliance, see *Section 2: Understanding Conformance.*

Conformance:

Successful testing of an implementation (i.e., product or application) to meet the requirements of a standard or specification. Conformance only applies to and can be tested for a given specification. Therefore, it is not conformance to SCORM® (for example), but rather conformance to a specific version of a standard or specification, such as content metadata, content packaging, etc. We recommend that conformance be the term used, and to avoid the use of compliance or compliant. A buyer's or supplier's interest in conformance should be based on those specifications relevant to their needs and purpose. For more information about conformance, see *Section 2: Understanding Conformance*.

Note on Conformance from the ADL:
It is important to note that self-testing and demonstration activity in no way implies certification of any participant's products by ADL or any other involved company or organization. Results of conformance testing can not be used to indicate any kind of endorsement or product certification by ADL or any other participating company or organization. Currently, there are two authorized organizations responsible for certifying products that conform to SCORM specifications. These products then can carry the ADL certification logo and are listed as certified on the Website. For more information on ADL certification, go to http://www.adlnet.org.

Content Management System (CMS):

A centralized software application or set of applications that facilitates and streamlines the process of designing, testing, approving, and posting e-Learning content.

Content Package:

Information that provides a standardized way to exchange digital learning resources between different systems or tools. Content Packaging also can define the structure (or organization) and the intended behavior of a collection of learning resources. Content Packaging defines, among other things:

- a manifest file describing the package itself;
- how to create an XML-based manifest; and
- directions for packaging the manifest and all related physical files into a zip file or onto a CDROM, etc.

Content Repository:

A digital storage area that is used to organize learning objects, information objects, digital assets and courseware. Such repositories can be used to partition its content and label it using metadata and multiple taxonomy schemes.

Content Structure:

Defines a mechanism that can be used by the content developer with the means to author and aggregate collections of learning resources into a cohesive unit of instruction (i.e., course, chapter, module, etc.), apply structure, associate learning taxonomies, and associate specific behaviors that can be uniformly reproduced across LMS environments. The content structure can be considered the map used to sequence and navigate through the learning resources defined in the content package. The content structure contains the structure of the learning resources and behaviors to be applied to the learning experience. Content Structure does not define LMS functionality.

Data Model:

A conceptual representation of the data structures that are required by a database. The data structures include the data objects, the associations between data objects, and the rules which govern operations on the objects. As the name implies, the data model focuses on what data is required and how it should be organized rather than what operations will be performed on the data. To use a common analogy, the data model is equivalent to an architect's building plans. The data model is 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 learning content 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 re-use across multiple systems is to occur. Structured data is at the heart of the modular content paradigm upon which things like Learning Objects are based upon.

Durability:

The ability to withstand technology changes without redesign, reconfiguration, or recoding.

e-Learning:

Learning or training that is prepared, delivered, or managed using a variety of learning technologies, and that can be deployed either locally or globally. Term covering a wide set of applications and processes, such as Web-based learning, computer-based learning, and digital collaboration. It includes the delivery of content via Internet, intranet, extranet, virtual private network, audiotape, videotape, satellite broadcast, virtual classroom, interactive television, CD-ROM, DVD, PDA, and other delivery platforms.

Enterprise Resource Planning (ERP):

A broad set of activities supported by multi-module, database application software that helps a business manage many facets of the company's operations, including purchasing, product planning, inventory management, supplier interactions, customer service, financial resources management, and human resource activities.

Extensibility:

The ability to expand and adapt an application or infrastructure by adding functionality or services to a core set of capabilities as e-Learning technology and requirements evolve. The framework must allow for additional elements to be integrated easily using some form of open and component-based software architecture. Examples: extending the use of the same content from a PC to a PDA; re-purposing learning content from within your firewall and exposing it to external learners via your LMS.

Extensible Markup Language (XML):

XML enables designers to create their own markup tags, and still allow interoperability of data between applications. For example, an XML tag can define the author by using "*<author>*" as a markup tag. A LCMS can define collections of XML-tagged learning objects, which in turn a LMS can aggregate and present personalized content to the learner.

Extensible Stylesheet Language or Extensible Style Language (XSL):

A Web page design code that creates style sheets for XML pages, which separate style from content so that developers can specify how and where information is displayed on the page.

Federated:

In the context of learning and standards, *federated* refers to a method by which a collective set of content repositories are cross-referenced to provide a shared environment for searching and retrieval of content. If federated repositories use common metadata elements across multiple storage environments, they facilitate the discovery of the best resource that matches a specific search query.

Globalization:

The tailoring of content to: include clear, grammatically-correct text that eliminates slang, colloquial speech and generational idioms; omit references to culturally-specific content; and facilitate similar understanding of content across cultural and linguistic boundaries.

Granularity:

The level of divisibility and accessibility used to create, aggregate, and re-use learning content within a system.

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. An effective e-Learning framework must allow content and other data to be exchanged and shared effectively by separate tools, software, and systems connected via the Internet or a network. The network and Web protocols or technologies allow content structures to be exposed in a manner that allows content packages, in whole or part, to be re-used in other contexts. Note: there are multiple levels of interoperability.

Learning Object (LO):

A re-usable, media-independent chunk of information used as a modular building block for e-Learning content. Learning objects are most effective when organized by a metadata classification system and stored in a content repository such as a LCMS. . For more information on Learning Objects, see *Section 4: Learning Objects—Building Blocks for Learning.*

Learning Object Metadata (LOM) Standard:

A set of Learning Object metadata elements and their underlying attributes that help define and categorize them. The LOM is a multi-part standard that specifies a conceptual data schema that defines the syntax and structure of metadata values for a Learning Object, which is defined by the IEEE LTSC Learning Object Metadata Working Group as "any entity - digital or non-digital- that may be used for learning, education or training." A metadata tag for a Learning Object describes relevant characteristics of the learning object to which it applies, and can be grouped into the following nine categories: general, life cycle, meta-metadata, technical, educational, rights, relation, annotation, and classification. The purpose of this standard is to facilitate storage, search, evaluation, acquisition, and use of learning objects by learning content authors, instructional designers, instructors, learners, and automated software processes. This standard also facilitates the sharing and exchange of Learning Objects, by enabling the development of Learning Object repositories, catalogs, and inventories while taking into account the diversity of cultural and lingual contexts in which the learning objects and their metadata are managed and reused.

Learning Content Management System (LCMS):

A multi-user software application that enables content authors to manage the life-cycle of learning content by allowing them to create, register, store, assemble, re-use, and publish digital learning content for delivery via Web, print, CD, etc., within a central object repository. LCMSs often structure and assign metadata to content at multiple levels of granularity.

Learning Management System (LMS):

Software that automates the administration of training events and contains organizational information such as role-based curricula, learner profiles, training histories, competencies, and training resources. A learner's development plan and job-related training can be stored and personalized to the individual. A LMS provides an environment for learner registration, populates courses in a catalog, records data from learners; and supplies reports to management. A LMS is typically designed to handle courses by multiple publishers and content providers, both internal and external to an organization. Many LMSs are designed to conform to specifications for content interoperability.

Localization:

The tailoring of content to be correctly interpreted in local geographies, using simple business language, and making content very culture- or language-specific for the target audience.

Manageability:

The ability for a system, such as a LMS, to track the appropriate information about the learner and learning content.

Manifest:

A manifest is an XML file that describes the components of a content package. The manifest consists of the following sections:

- metadata section that describes the package as a whole;
- organizations section that describes one or more hierarchical organizations of the content (content structure); and
- resources section that references the actual resource and media files necessary for the content.

MASIE Center e-Learning CONSORTIUM:

A collaboration of major corporations, government agencies, and e-Learning providers focused on the future of e-Learning.

Metadata:

The information which describes other information, such as learning content, and allows it to be stored, indexed, searched, and retrieved from a database or repository. The purpose and usefulness of metadata in e-Learning is that it provides the ability to use attributes that richly describe and identify learning content to find, assemble, and deliver the right learning content to the right person at the right time. For more information on metadata, see *Section 3: Metadata – Why Implement?*

Metadata tag:

A category of information that describes a Learning Object. Examples include author, publisher name, keywords, version, language, learning objectives, etc.

Metadata attribute:

A specific piece of information that describes a Learning Object. Examples include: Kathleen J. Tinker (author); ABC Medical Training

Department (publisher); cardiovascular, hypertension (keywords); revision 2a (version), Spanish (language); the learner will be able to state the causes, and treatment of hypertension (learning objective).

Modularity:

The systematic creation and organization of learning content into discrete units that maximizes their re-usability within other learning contexts.

Ontology

An ontology is an explicit specification of a conceptualization and can determine the relationships between items classified in taxonomy schema. An ontology provides a set of well-founded constructs that can be leveraged to build meaningful higher-level knowledge. The key ingredients that make up ontologies are vocabularies of basic terms and a precise specification of what those terms mean. Ontologies enable communication between computer systems in a manner that is independent of the individual system technologies, information architectures, and application platform. A commitment to a common ontology is a guarantee of consistency, but not completeness, with respect to queries and assertions using the vocabulary defined in the ontology. Ontologies are relevant and important in the context of learning and standards as they serve the purpose of enabling knowledge sharing and reuse across multiple sets of information. In that context, an ontology is a specification used for making relational commitments between content and information.

Question & Test Interoperability (QTI) Specification:

The IMS QTI specification defines an XML language that can be used to represent questions and assessments in a platform and vendor-independent manner. By exporting questions and assessments into QTI XML, users of questions and assessments can put material in a standard format, which other systems can import and use. For more on QTI, see page 69.

Reference Model:

The selected standard used to guide development, delivery, and implementation of e-Learning content, technologies, and their interoperability. The ADL's SCORM document is an example [http://www.adlnet.org].

Resource Description Framework (RDF):

A foundation for describing and interchanging metadata between applications. RDF can be used in a variety of application areas; for example: to provide better search engine capabilities; in describing the content and content relationships available at a particular Website, page, or digital library; to facilitate knowledge sharing and exchange; and to describe intellectual property rights of Web pages.

Re-usability:

The flexibility to incorporate instructional components in multiple applications and contexts.

Rich Site Summary (RSS):

An XML-based format that allows the syndication and sharing of Web content. RSS lets users select content in which they are interested, and then allows their computers to track, fetch and understand the information to deliver personalized content to the user.

Run-Time Environment:

Launching, communicating with, and tracking content in a Web-based environment. This communication takes place between a LMS and learning content through a browser or a virtual classroom tool, etc.

Scalability:

The degree to which a computer application or component can be expanded in size, volume, or number of users served.

Schema:

A metadata schema provides an ontology aimed at identifying the structure of knowledge in a given discipline and linking these structures into a larger whole through the creation of a system of information that assists the identification, discovery and transaction processes of the given discipline structures.

Section 508:

The section of the United States1998 Rehabilitation Act which states that all electronic and information technology procured, used, or developed by the federal government must be accessible to people with disabilities. Affected technology includes hardware such as copiers, fax machines, telephones, and other electronic devices as well as application software and Websites.

Sharable Content Object (SCO):

[from SCORM version 1.2]. A SCO represents the lowest level of granularity of learning resources that can be tracked by a LMS. A collection of one or more assets that include a specific launchable asset that utilizes the SCORM RunTime Environment to communicate with a LMS. To be re-usable, a SCO by itself should be independent of learning context. For example, a SCO could be re-used in different learning experiences to fulfill different learning objectives. In addition, one or more SCOs can be aggregated to form a higher-level unit of instruction or training that fulfills higher level learning objectives. SCOs are intended to be subjectively small units, such that potential re-use across multiple learning objectives is feasible. A SCO can be described with SCO metadata to allow for search and discovery within online repositories, thereby enhancing opportunities for re-use. For more information about

SCOs, see *SCO and SCORM* in *Section 4: Learning Objects—Building Blocks for Learning.*

Sharable Content Object Reference Model (SCORM):

A standards reference model that incorporates defined standards (such as IEEE and AICC), that can be applied to course content, virtual classroom technologies, LMSs, and LCMS tools to manage the creation, publishing, and delivery of re-usable Learning Objects. As a result of the U.S. Department of Defense's Advanced Distributed Learning (ADL) initiative, courseware elements following SCORM standards can be easily merged with other elements that conform to the standard to produce a highly modular and interoperable repository of training content. For more information about SCORM, see *What Is SCORM?* page 15 and *SCO and SCORM* in *Section 4: Learning Objects—Building Blocks for Learning.*

Simulation:

Interactive learning content or environment in which the learner can practice or role-play a specific task or behavior. During a simulated learning environment, the learner can practice job-related performance tasks within a “safe” setting.

Specification:

A documented description stating functional requirements. Some "specs" become standards, which means they have received the stamp of accreditation after having proceeded through the four stages outlined in *How Standards are Formed* in this document. In some industries, something cannot be sold until it receives a stamp of approval by the government (i.e., electrical devices are accredited by IEEE).

Standard:

There are two types of standards:

- de jure Standards:
  [By right; of right; by law; often opposed to "de facto"]
  The designation or certification of a specification's status by an accredited body such as IEEE LTSC, ISO/IECJTC1/SC36, or CEN/ISSS (European).
- de facto Standards:
  [Existing in fact whether with lawful authority or not]
  Typically, when a critical mass or majority choose to adopt and use a specification. For example, TCP/IP, HTTP, VHS, etc., are all "de facto" standards.

Specifications evolve and become standards over time and go through several phases of development before they become widely adopted or become *de facto*. While there is no absolute process in the creation of *de jure* standards, one can abstract an overall and highly iterative process model where the following four stages are typical:

1) R&D; 2) Specification Development; 3) Testing/Piloting; and
4) Accredited and International Standard Status.

The ideal state is when a *de jure* standard is also *de facto*! (e.g., HTTP). For more information, see *How Standards Are Formed* in this document.

Taxonomy:
: Hierarchical levels which can be ascribed to learning content. Note: multiple classification schemes, or taxonomic hierarchies, may be adopted to describe one piece of learning content.

Translation:
: The conversion of learning content into another language or dialect to accurately replicate it within an equal instructional context.

Virtual Classroom:
: An online learning environment that provides facilitated, interactive instruction and peer-to-peer learner interaction during real-time events.

Wireless Markup Language (WML):
: XML-based language that codes a media-reduced version of Web content to be displayed on cellular phones and PDAs.

Additional Resources

See additional terms and definitions in the following resources:

ASTD Learning Circuits
http://www.learningcircuits.org/glossary.html

Brandon Hall: New Technology Definitions
http://www.brandonhall.com/public/glossary/

Cisco Systems
http://www.masie.com/standards/s3supplement/elearn_glossary.pdf

ELearn Frame: Glossary of e-Learning Terms
http://www.learnframe.com/aboutelearning/glossary.asp

e-Learning Guru
http://www.e-learningguru.com/gloss.htm

e-Learning Site: Glossary
http://www.e-learningsite.com/elearning/glossary/glossary.htm

Internet Time
http://www.internettime.com/blog/archives/000015.html

References

Advanced Distributed Learning Initiative (2001), Sharable Content Object Reference Model, Version 1.2 [http://www.adlnet.org].

American Society for Training & Development (2001), ELearning Glossary [http://www.learningcircuits.org/glossary.html].

Gruber, Tom (2003), What is an Ontology? [http://www-ksl.stanford.edu/kst/what-is-an-ontology.html]

Institute of Electrical and Electronics Engineers, Inc. [http://www.ieee.org]

International Organization for Standardization [http://www.iso.org].

Rosenberg, Marc J. (2001), eLearning, New York: McGraw Hill.

Section 508 of the Rehabilitation Act: Electronic and Information Technology [http://www.section508.gov].

Singh, Harvi. (2000), Achieving Interoperability in eLearning, Learning Circuits, [http://www.learningcircuits.org/mar2000/singh.html].

Web.resource.org [http://web.resource.org].

The MASIE Center
Learning and Technology e-Lab & ThinkTank

The MASIE Center is a thinktank dedicated to exploration and research on how new technologies, such as the Internet and wireless communications, can be used by people and organizations to deliver training, learning, collaboration, and better ways of working. We provide the following research-based services on issues and trends that impact the learning and technology industry:

e-Learning CONSORTIUM: The e-Learning CONSORTIUM is a collaboration of major corporations, government agencies, and e-Learning providers focused on benchmarking and the future of e-Learning. Through this CONSORTIUM, members network, learn, and share their experiences, best practices, and lessons learned. They actively participate and collaborate on dynamic benchmarking of their e-Learning activities (e.g., what and how specific e-Learning technology is being implemented within their organizations) and in targeted research (e.g., the attitudes and preferences of learners toward e-Learning).

The members of the e-Learning CONSORTIUM are a prime focus of our work in the e-Learning arena and the focus of MASIE Center staff efforts, research and support.

MASIE Center Events & Seminars

- **Biz Learn:** An annual event focused on the Business of Learning and Procurement of Learning/Training Products and Services
- **LMS SIG:** An annual event focused on the benchmarking of best practices on using a Learning Management System
- **Virtual Classroom/Digital Collaboration SIG**: An annual event focused on the benchmarking of best practices for teaching and presenting online.
- **e-LAB:** A usability and research facility testing the behavioral aspects of new learning products and approaches from a user and buyer perspective.
- **Strategy Retreats:** We have constructed an environment for groups working on their e-Learning Strategies. You and your teammates will have an opportunity to work in the Strategy Arena to plan how e-Training Skills can be integrated into your organizational plan and strategy.
- **Consulting:** Elliott Masie and the MASIE Center staff provide targeted, extremely short-term strategic coaching to implementation groups, executive staff, and vendors on new products and services.

More information at:

h t t p : / / w w w . m a s i e . c o m

The Instructional Use of Learning Objects

ONLINE VERSION

This is the online version of *The Instructional Use of Learning Objects*, a new book that tries to go beyond the technological hype and connect learning objects to instruction and learning. You can read the full text of the book here for free. The chapters presented here are © their respective authors and are licensed under the Open Publication License, meaning that you are free to copy and redistribute them in any electronic or non-commercial print form. For-profit print rights are held by AIT/AECT. The book was edited by David Wiley, and printed versions of the book are published by the Association for Instructional Technology and the Association for Educational Communications and Technology. If you find the online book useful, please consider purchasing a printed copy.

In addition to reading the book, at this website you can participate in discussions of the book's chapters with the authors and others, submit any corrections should you find errors in a chapter, and discuss other issues related to learning objects, instruction, and learning.

News: *February 2002*. The book website is now the first result on Google when searching for learning objects! Thanks to everyone who has enjoyed and linked to the book!

August 2001. The book is off the press and now available for purchase! Buy the book here! There has been a delay adding the nicely formatted PDFs of the book chapters to the website (to replace the awful Word files); however, they *are* coming. Thanks for your patience.

May 2001. The book has gone to the printer as of 9:00am, May 30th! Links for ordering print copies will be available soon. Also, watch for nicely formatted chapter PDFs to replace the ugly Word files below sometime next week!

April 2001. During April of 2001 we saw the 10,000th chapter downloaded (six months from site launch)! Thank you for your continued support and interest in The Instructional Use of Learning Objects. Please don't forget to take part in a Chapter forum if you feel so inclined.

November 2000. Site launch! The chapters below have not yet undergone their final pre-print-publication formatting. Until this occurs they will only be available in MS Word format. I apologize for the inconvenience.

The book is divided into five major sections.

Click on a section heading above to go directly to that section, or scroll down to browse the entire book.

1.0. Learning objects explained

2.0. Learning objects and constructivist thought

3.0. Learning objects and people

4.0. Learning objects implementation war stories

5.0. Learning objects and the future

This site is maintained by David Wiley. Please feel free to send complaints, suggestions, or (heaven forbid) praise to david.wiley@usu.edu.

The Instructional Use of Learning Objects

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