Cisco Systems

White Paper

Reusable **Learning Object Strategy:** Designing and Developing Learning Objects for Multiple Learning Approaches

Over four years ago, Cisco published a strategy for developing and implementing reusable learning objects (RLOs) and their associated structure and assets. These learning objects are based on a single learning or performance objective, and they are built from a collection of static or interactive content and practice activities. The components of a learning object can include assessments to measure a learner's mastery of the objective. Individual assessments may be positioned within the learning object or collected separately as an assessment group. Learning objects are identified with metadata so that they can be referenced and searched both by authors and learners.

During this four-year period, Cisco has refined its definition of a learning object, as well as its learning object implementation strategy. Given their granular structure, learning objects can be combined to form a hierarchy, such as lesson, module, course, or curriculum. This structure gives the objects the context necessary to ensure a meaningful learning experience. It also allows the same learning objects to be leveraged in problem-based learning, exploratory environments, performance support systems, job aids, help systems, or blended learning solutions.

This RLO strategy incorporates many lessons learned and best practices—from our authoring community, external standards groups, peer organizations, employees, and customers. In this paper, we refine and update the strategy, based upon this implementation experience. Although there have been many changes to the strategy, we keep the basic premise of learning objects and their utility intact. We expect the RLO strategy to mature over time. We intend to provide richer case studies and examples and to continually reflect on our journey as we support the Cisco learning ecosystem.

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Foreword

The original RLO strategy was defined in the fall of 1998 by a cross-functional team at Cisco Systems. During the period since then, Cisco's overall Learning Solution Architecture and metadata strategy have emerged, as has the maturity of object strategies and tools outside of Cisco. We are actively engaged in sharing this vision and participating in standards groups such as IMS and ADL (see References section). Many challenges have also been overcome in the application of the RLO strategy thanks to the work of many at Cisco, as well as our external partners, customers, and other individuals. It is impossible to recognize everyone who has played a role in this shared vision.

A few of the many contributors at Cisco:

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If you have questions about the RLO strategy, forward them to RLO-feedback@cisco.com. The Learning Design and Management team at Cisco will attempt to answer your query in a timely manner.

Audience

This document assumes that the reader has experience in course development, training, or instructional design, or is responsible for creating content and information that will be used to build learning objects. Designers and architects of content, delivery, and learning management systems may also find this document useful as a case study application of learning objects.

The Evolution of the Strategy

The reusable learning object (RLO) strategy provides a process and framework used to create and deliver learning experiences that support the performance of Cisco employees, partners, and customers. These learning experiences are constructed out of existing learning objects (combined with any required new learning objects) to build solutions in multiple learning approaches for a robust set of performance needs and delivery options.

This strategy is evolving from the realization that effective training consists of more than the large inflexible "course." Effective training focuses on the learner's experience and accommodates multiple approaches to learning. It incorporates problem solving, use cases, context-rich stories, real-world simulations, and personalized dynamic delivery that is adjusted to fit the learner and the delivery system. All of these rich modalities are part of a dynamic and flexible model that lowers costs and brings higher value to the learner and the business.

The RLO strategy captures a snapshot-in-time of that realization. In this paper, we present a definition of learning objects, discuss their importance and utility, suggest a process for designing, developing, and implementing them, and present examples from within Cisco.

Updates in Version 4.5

Cisco has been refining its definition, implementation, and use of learning objects over the last four years. Version 4.0 of the RLO strategy was posted to our website in December 2002. Many lessons and best practices have been learned in that time from our author community and learners. Cisco has participated in many conferences and standards groups on the subject of learning objects. All have helped to refine our strategy.

Specifically, these changes have been made in Version 4.5:

- New logical flow to improve readability and parity with other white papers posted at Cisco.com. Companion white papers have recently been added to Cisco.com on the subject of e-learning, supporting architectures and the learning experience at Cisco.
- Ability to apply learning objects according to multiple learning approaches, such as receptive, directive, guided discovery, and exploratory. These approaches are introduced in this document, and then further detailed in Cisco's "Enhancing the Learner Experience" white paper at Cisco.com.
- Introduction of a number of changes in the current design process during implementation of a learning object strategy. As a result, a modified design process is presented and compared to a more traditional design and development process. The new process is called the "Learning Object Development (LOD) process."
- Separation of the strategy from the guidelines and templates that are used to form learning objects within ILSG. Those guidelines can be found in the "Reusable Learning Object Authoring Guidelines v1.0" white paper.
- Use of the generic term "learning object" in the majority of this document to avoid confusion between the terms "reusable learning object" and "reusable information object" (RIO) coined in the prior versions of this paper. It was felt that the process of designing, developing, and implementing learning objects could better be described without use of the technical terms RLO and RIO.
- Elimination, clarification, and updating of many of the emergent concepts and assertions in prior versions, to increase readability and clarify Cisco's definition of the RLO strategy.

Looking to Version 5.0

Version 4.5 of the RLO strategy is a refinement of the prior version, providing the much-needed addition of the multiple approaches to learning. In updating this version, we realize that there are many other topics to be covered, from best practices to new and dynamic methods to enable learning across Cisco's "learning ecosystem." Our goal for Version 5.0 and beyond is to research, document, and implement the next "big thing" for learning at Cisco. Look for regular updates to this document and related documents to be posted to Cisco's public website.

Document Organization

Note that the bulk of this document focuses on the learning object development process. The other sections help support that process, explain the purpose and creation of a generic learning objects strategy, and provide examples of how Cisco has implemented its RLO strategy over the last four years.

This document is organized into the following major sections:

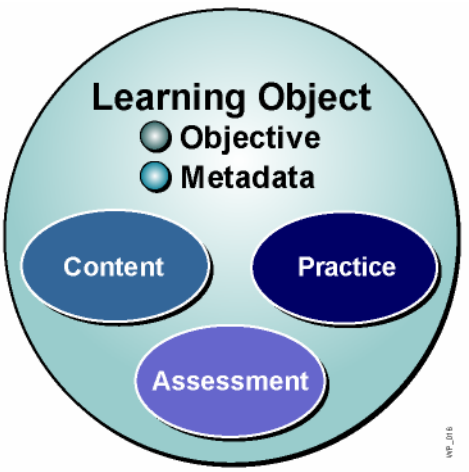
- What Is a Reusable Learning Object?
- Benefits of Learning Objects
- Implementation Challenges
- Learning Object Development Process
- Practice and Assessment
- Standards and Specifications
- Applying Metadata

What Is a Reusable Learning Object?

Ideally, a learning object is based on a single learning or performance objective, built from a collection of static or interactive content and instructional practice activities. Any learning object can be "tested" through assessments that measure the learning or performance objective and are either positioned with the learning object or collected as an assessment group. Within the learning object, content, practice, and assessment groupings are built from raw media assets such as text, audio, animation, video, Java code, applets, Flash, and any other asset needed for the given delivery environment. Finally, everything found in the learning object is identified with metadata so that it can be referenced and searched both by authors and learners.

With their granular structure, learning objects can be combined to form a hierarchy such as a lesson, module, course, or curriculum that gives the objects the necessary context in which to ensure a meaningful learning experience. Likewise, the same learning objects can be leveraged in problem-based learning, exploratory environments, performance support systems, job aids, help systems, or any blended learning solution.

Learning Object Structure



Common Terminology

The concept of reusable, granular objects stored in a database is common in fields of human performance technology and knowledge information management. In fact, many terms are used in the industry:

- Component
- Nugget
- Chunk
- Binary large object (BLOB)
- Assignable unit
- Sharable content object (SCO)

In addition to these terms, "objects" have been further classified into other types, based on their function or granularity. These include objects that are classified as information, knowledge, content, performance, support, reference, and context. Of these terms, the use of "learning object" and "information object" seem to be growing in popularity and acceptance. Likewise, "SCO" is increasing being used by those adopting the Advanced Distributed Learning specification known as the sharable content object reference model (SCORM).

Standard Definition

Within the learning industry, there are a number of specification groups and standards groups that have also offered their definition of learning objects. The definition that seems to be the most cited is from the IEEE (www.ieee.org).

Within the IEEE standards body, there is a subgroup that focuses specifically on learning technology standards, such as learning objects and their associated index information (or metadata). This group is known as the IEEE P1484.12 Learning Object Metadata Working Group of the IEEE Learning Technology Standards Committee (LTSC) (http://ltsc.ieee.org/wg12/s_p.html). Its definition of learning object reads as follows:

> "A learning object is any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Examples of technology-supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, and collaborative learning environments."

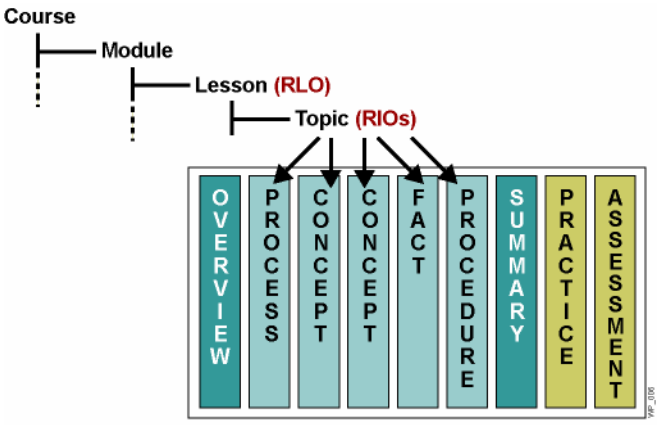
While this definition provides a good conceptual starting point for the discussion of the size and shape of a learning object, its flexibility actually makes its broader utility difficult. Cisco and other organizations have chosen to create definitions for learning objects that better fit their goals and needs based on a number of criteria, including business needs, hierarchy, instructional approach, audience, and delivery media.

See Appendix B for more information about specifications and standards groups.

Learning Object Hierarchy

Version 4.0 of the RLO strategy introduced a simple two-level hierarchy consisting of an RLO and RIOs. For the learner, we use the term "lesson" for an RLO and "topic" for a RIO. For an ILSG instructor-led course, the complete hierarchy is represented in the following figure, which demonstrates a typical Cisco learning object hierarchy and structure. The lesson includes an overview, summary, practice, and assessment with a collection of topics in the middle.

Directive Course Hierarchy



In this example, the topics in the lesson are classified based on their instructional purpose. These topics are based on the five information types defined by Ruth Clark in *Developing Technical Training* and modified by Cisco Systems. The five types (concept, fact, process, principle, and procedure) are helpful for authors in that they provide a template for creating the content, practice, and assessment that form the learning object. Keep in mind that this example shows a directive learning approach. Later in this document we will present other learning approaches built from learning objects that are classified in this manner.

Simplified Terminology

While the RLO/RIO terminology helped to define the original RLO strategy, having two terms proved confusing to some authors. In addition, the growing body of practice in the field of learning objects has shifted the distinction between learning and information objects. In order to simplify the terminology in this document, and align with external definitions of learning objects, this version of the RLO strategy treats each level of a course hierarchy as a learning object.

If you are familiar with the prior terminology, this may seem like a major change, but as you will see, Cisco still believes in classifying learning objects as a concept, fact, process, principle, or procedure. Also, within ILSG, the terms "RLO" and "RIO" are generally replaced by "lesson" and "topic," respectively.

Benefits of Learning Objects

The benefits of adopting a learning object strategy vary based on your development process, authoring and delivery tools, and integration with existing content management, knowledge management, and learning management systems. Even so, there are a number of potential benefits for authors, learners, and organizations.

For Authors

For authors, a learning object strategy accomplishes the following:

- Supports the design of many learning approaches, including receptive, directive, guided discovery, and exploratory
- Ensures, through the use of object-specific templates, that design and development of learning products are consistent across the organization
- Provides a consistent design structure early in the development process, maximizing resource allocation while minimizing development risks
- Provides guidelines for authors, improving their ability to write effective and efficient performance-based training, assessments, and resources
- Enables detailed searches that allow authors to find, reuse, and repurpose any object or media
- Allows authors to combine old and new objects to build new solutions to meet the needs of their learners
- Supports both reuse and repurposing from the smallest media element up to larger course structures and learning contexts
- Enables application of delivery formats and styles to the learning objects as they are "published" for delivery (also known as single-source development), saving time and resources when authors are developing and maintaining learning products
- Supports a broad range of delivery types, including instructor-led training (ILT), self-paced e-learning training, performance-support tools, virtual classrooms, personal digital assistants (PDAs), or blended delivery solutions

For Learners

For learners, a learning object strategy accomplishes the following:

- Provides a mechanism for learners to self-assess their skills and knowledge in order to receive a prescribed course of action for future learning
- Supports the acquisition of new skills and knowledge through education, experience, or exposure
- Supports multiple delivery types, media types, and presentation styles to fit a learner's needs, preferences, and work environment
- Enables, through the use of detailed metadata about each object, custom learning paths to be tailored to the knowledge and skills that individual learners need for their job
- Enables learners to search on job-specific objects and efficiently access the right amount of knowledge as it is needed
- Delivers a consistent learning experience with each deliverable using learning objects, including job aids, classroom training materials, e-learning, and blended delivery formats
- Supports multiple learning approaches, ranging from passive, receptive training to discovery and problem-solution based training

For Organizations

For organizations, a learning object strategy accomplishes the following:

- Reduces the costs, when the strategy is implemented correctly, in each phase of the development process by using a standardized structure and format
- Scales the development model by allowing the use of many development partners through the publication of a standard and related tools for learning object development (LOD)
- Increases the speed to successful performance and competency by employees by using a database of existing learning objects to build new solutions quickly
- Decreases development and maintenance time to support both exams and courses by using a common database of learning objects
- Allows the rapid creation of certification materials by leveraging granular, focused learning objectives that support both the certification exams and learning objects
- Personalizes learning approaches and delivery types, resulting in improved learner satisfaction and enhanced transfer of knowledge and skills
- Aligns content found in learning content management systems with knowledge management systems across the enterprise

Implementation Challenges

While there are many benefits to adopting an RLO strategy, there are many challenges to overcome. They can range from tools and systems to writing styles and guidelines. Some challenges may be significant enough to limit the scope of your learning object strategy or require you to phase in the strategy over time. We cannot anticipate every challenge that you may face, but the following are some of the challenges that Cisco has faced during the years since the RLO strategy was initiated.

More Than Reuse

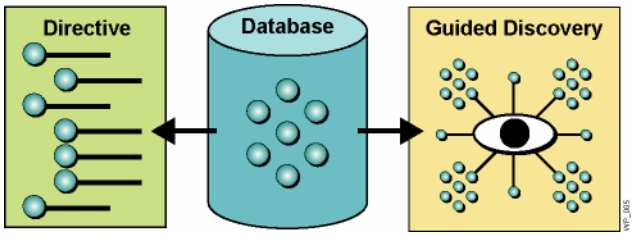
Over the last four years, Cisco has focused less on the idea of "reuse" as being the sole benefit and business driver for the RLO strategy. In fact, many authors are more comfortable with the idea of "repurposing" content instead of reusing it without exception. Typically, authors find learning objects a useful "base" for content that they can modify to fit their specific needs. To overcome this challenge, each organization should look at the possible return on investment (ROI) of reuse versus repurposing, and the level of change allowed for any existing learning object. Based on the level of ROI required by the organization, authoring guidelines can be established.

In the remainder of this document, we focus more on possible uses and benefits for learning objects – beyond reuse. While we still support reuse as a key benefit, it is easy to get caught up in a debate over granularity, content, continuity, and context that takes away from other reasons for adopting an RLO strategy.

Multiple Learning Approaches

Supporting multiple learning approaches was not defined in the earlier RLO strategy because the focus was on traditional directive learning structures. These approaches were easy to apply because, with their granular structure, learning objects could be combined to form a hierarchy of lesson, module, course, or curriculum. We now realize that, with the proper tools and upfront design, the same learning objects can be leveraged into problem-based learning, exploratory environments, performance support systems, job aids, help systems, or any blended learning solution. The following figure shows conceptually how a single database of learning objects can support directive and guided-discovery learning approaches through the sharing of common learning objects.

Supporting Both Directive and Guided Discovery

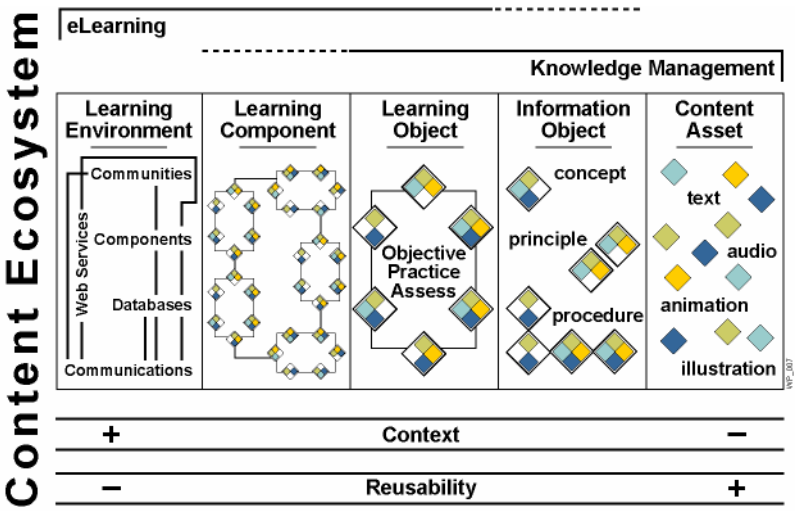


Granularity and Context

Most people who are implementing learning objects agree that context is a critical element in creating a meaningful learning environment. All but the most expert employee (learner) will need some structure to create a learning experience which transcends beyond access to the raw database of disassociated assets. The assets need to be combined and structured into a context and learning approach that relates to a specific job or task.

This need may seem counter to the ideal of granular, learning objects that can be used in multiple contexts, learners, and delivery environments. Generally speaking, as you move higher up in a given "course" hierarchy, there is greater context and less reuse (see the following figure).

Context and Reuse Relationship (Source: www.learnativity.com, Wayne Hodgins, 2002)



For example, a specific procedure on checking e-mail may be reused in many courses, but to be effective, it needs to be found in the context of other learning objects that form the lesson, module, and course. Of course, this hierarchy may not exist for a guided-discovery learning approach built to simulate an actual work environment that references learning objects.

Need for Writing Guidelines

Creating learning-object-oriented writing guidelines is a challenge that may seem easy to overcome, but as Cisco has discovered, reuse and granularity quickly complicate these guidelines. For example, Cisco has created the following writing examples to show authors how their writing style affects possible future reuse in multiple delivery formats. In this example, the learning object writing style is the most reusable.

Establish Writing Guidelines

ILT Printed	E-Learning	Learning Object
In the space below, write the letter of each icon that represents its corresponding command description.	Drag each command description to its corresponding icon.	Match each command description to its corresponding icon.
For details, refer to Appendix C: *Implementing IP QoS in ATM Networks*.	For details on IP QoS, click here to view the related Cisco white paper.	For details, refer to the Cisco white paper, *Implementing IP QoS in ATM Networks*, at www.cisco.com/ipqos.

These two guidelines were taken from a much larger writing guidelines document used internally by Cisco ILSG to help their authors create valid learning objects. To implement the guidelines, both authors and editors need to keep track of which level of the hierarchy the object resides in, the need for context between learning objects, and possible exceptions to those guidelines created by the desire to support flexibility and creativity.

Other Challenges

Implementing an RLO strategy poses the following additional challenges:

- Selecting an authoring tool that is based on open standards is easy to learn, and supports all the requirements of an RLO strategy while at the same time being easy to integrate with existing tools and systems within your organization.
- Allowing for flexible authoring guidelines and templates for maximum creativity in training development, while enforcing enough structure to allow for learning objects to be accurately classified.
- Proving that the additional effort of adding metadata (for example, search terms, rights, author, audience, and so on) for each learning object that is created is worth the benefits. In other words, no one should be capturing extra data that cannot be used by the authors, the learners, or the application.
- Creating the business rules that support the RLO strategy and may not be enforced by authoring tools—rules such as ownership, change notification, editing rights, charge-backs to other groups, writing guidelines, and so on.
- Accommodating the possible impact on timelines, resources, and costs in supporting new models and processes for development, production, editing, and distribution.
- Encountering resistance to a new authoring tool with fewer writing and editing “bells and whistles” for writers, instructional designers, and editors.
- Adapting to the fact that new authoring and delivery tools often have less support and may suffer from frequent upgrades that impact the ongoing cost of ownership and training.
- Having content that is less reusable for other audiences because of the inclusion of context at a granular level to benefit a specific audience.

Learning Object Development Process

A design and development model is a set of repeatable processes used to design and develop any solution that meets your needs. It allows you to define the project scope, meet milestones, achieve stakeholder approval, and evaluate the success of your solution. Normally, a design and development model begins with the analysis of a training need or performance gap, proceeds through design and development phases, and concludes with delivery and evaluation. The result should be a learner experience that meets the needs of both the learner and the business that sponsored its development.

This section discusses how a learning experience built from learning objects is created, using a development model that begins with analysis, ends with delivery, and includes evaluation. In addition, a traditional development process is compared to a process that accounts for challenges and adjustments made when you are implementing a learning object strategy.

Traditional Development Process

A common model used for developing training programs is the ADDIE model, presented in *The Conditions of Learning* by Robert M. Gagné (1965). The ADDIE model presents five phases to develop a training event or performance solution: analyze, design, develop, implement, and evaluate.

1. **Analyze:** Determine the cause of a performance problem or the need for the learning experience. Identify a solution that may include training, tools, motivation, and management. Through interviews, research, and observation, define the job tasks and specific performance goals to be addressed by the solution. If the problem can be "solved" through development of a product (for example, a "training course" or some other learning experience), then proceed to the design phase.
2. **Design:** Using the findings of your analysis phase, describe learning objectives, assessments, content structures, learning strategies, and desired learning experience. Produce a design document as a blueprint for developers and to obtain sponsor approval.
3. **Develop:** Based on the design document, research and write the content for the solution and build the supporting tools and delivery environment necessary for implementation.
4. **Implement:** Deliver the learning experience to the intended audience with the resources needed to ensure its successful adoption.
5. **Evaluate:** Determine the impact of the learning experiences or performance solution on the learner and the business. Analyze learner satisfaction, acquired learning, learning-to-job transfer, and ROI.

Your organization has most likely created a process for designing and implementing learning products and performance solutions. The important point is to have a process that is repeatable, can be used to gauge project scope and schedules, and, ultimately, provides a solution that meets your needs.

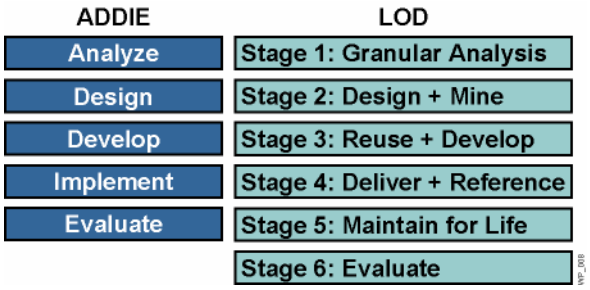
Adjusting the Process for Learning Objects

In creating learning experiences from learning objects, you will find it helpful to follow a design and development process just as you do today. At Cisco, the ILSG has created its own detailed design and development process called the Product Life Cycle (PLC). The PLC encompasses an LOD model that is based on ADDIE but is modified to fit the realities of developing solutions with learning objects and to fit all aspects of the learning ecosystem.

While the PLC is very complete, it is specific to ILSG. To generalize this process, an LOD process is presented. This process accounts for changes that you may want to make when creating learning environments that are based on learning objects.

The LOD process should help you understand the unique characteristics of creating solutions from learning objects. In addition, the LOD process supports all four of Dr. Ruth C. Clark's learning architectures (receptive, directive, guided discovery, and exploratory) and allows for both behavioral and constructivist training and performance solutions.

Accounting for Learning Objects in the ADDIE Process



The actual differences between your design and development process and the LOD process depend on the specific tools, systems, authors, and resources used in its implementation.

Stage 1: Granular Analysis

This stage of the LOD process explores all the factors that affect the performance gap of your target audience, identifies the desired performance outcomes, and uses that information to select the best intervention. Although this stage is nearly identical to that found in the ADDIE process, the adoption of learning objects enables the collection of data and reports about each existing learning object.

A report, for example, can examine how the job performance of a given learner has changed as the result of completing a training solution built from learning objects. Because the training solution is built to meet a specific need or learning objective, a negative change can indicate many problems. These problems can indicate a number of opportunities to improve the learning environment, increase management support of the solution, augment the learner's prerequisite knowledge, or respond to other possible causes for the negative change.

Stage 2: Design and Mine

Design and Mine is the stage at which a training solution is structured, learning objectives are captured, content types are identified, and stakeholders agree that the solution meets the needs identified in the analysis phase.

This stage adds the idea of "mining" for learning objects, thereby looking for solutions that may exist and are already being used by the learner. An important function of a database of learning objects is the ability that it offers you to determine what has already been created, gather evaluation data and usage statistics, and add new elements to existing objects. How you adapt your design will depend on the authoring and delivery systems in place, and how easy it is for you to access data about past learning object usage.

At this stage, having valid metadata to search against is the key to success. This metadata includes information about the learning object, such as key words, identification of the owner, and the learning objectives. See Appendix C for more information about metadata.

During the design phase, you can identify learning objects that either match your needs exactly without modification or that can be repurposed (modified in some way). Ideally, you will document and promote the percentage of reuse and repurposing along with any associated cost savings.

In addition to these learning-object-specific changes, it is strongly suggested that you implement the following steps during this phase:

- Write Learning Objectives
- Identify the Cognitive Level
- Classify Learning Objects
- Identify the Primary Learning Approach
- Sign Off on the Design

Write Learning Objectives

According to Robert Mager's book, *Preparing Instructional Objectives*, there are three important benefits of writing learning objectives. First, when clearly defined objectives are present, there is a sound basis for the selection or designing of instructional materials, content, or methods. A second benefit is that the objectives allow you to be specific about what the learner needs to accomplish. Unless objectives are clearly and firmly fixed in the minds of both parties, tests are at best misleading; at worst, they are irrelevant, unfair, or uninformative. Lastly, and maybe most importantly, clearly defined objectives provide learners with the means to organize their own efforts toward accomplishment of those objectives. Ideally, learners will use their metacognitive skills to integrate the learning with the mental models they had formed through past experiences.

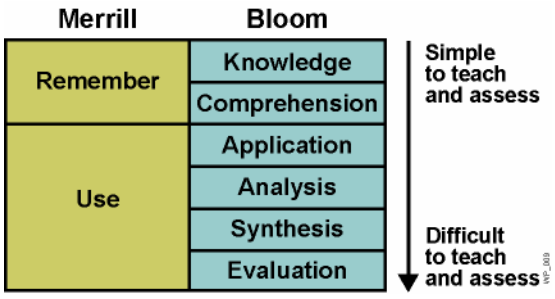
In your customized RLO strategy, you may find that you have different types of learning objectives, based on the scope of the learning experience and its related level in a directive RLO hierarchy. For example, you may find that you have broad learning objectives at the course level. As you progress down in the hierarchy from module to lesson and topic, you find that the learning objectives get more specific until you reach what is known as a "terminal objective." This objective is the measurable outcome that results from the learner successfully completing that learning object.

Identify the Cognitive Level

Just as important as a well-crafted learning objective is the identification of its cognitive level in the database of learning objects. Cognitive level is an important designation that identifies how learners will remember or use the skills and knowledge that they acquire through completing the learning object (both content and practice activities). When combined with the learning objective, the cognitive level identifies what the learner is required to remember or do to demonstrate mastery of a given learning object.

There are many methods of classifying cognitive levels. The RLO strategy applies the best practices and research found in Dr. David Merrill's component display theory, Dr. Benjamin Bloom's *Taxonomy of Educational Objectives*, and Dr. Ruth Clark's *Developing Technical Training*. This table compares Merrill's taxonomy (left) with Bloom's taxonomy (right). Merrill identifies two levels of cognition: Remember and Use. Bloom identifies six levels, ranging from Knowledge to Evaluation.

Comparing Cognitive Levels Between Merrill and Bloom



If the learner will simply need to recall knowledge but not actually do anything with that knowledge, then the practice item will require the learner to "remember" something. The assessment items will simply need to test learner recall of information and not the demonstration of higher cognitive functions.

Correctly applying the cognitive level may seem difficult to those new to Bloom's taxonomy. However, the verb contained in the learning objective phrase often gives authors a valuable clue that they can use to determine the cognitive level. For example, the verb "list" requires the learner to recall information, so the topic is tagged "Remember" and fits into Bloom's first category, "Knowledge." On the other hand, the verb "configure" requires the learner to do something, so the learning object is tagged "Use" and is categorized as "Application."

Classify Learning Objects

Within ILSG, authors use learning objectives to categorize each topic as a concept, fact, procedure, process, or principle. These five types are based on modified information mapping as defined by Dr. Ruth Clark in *Developing Technical Training*.

This is important because the information types provide a framework and proven methodology to facilitate learning. Guidelines have been developed for each type, and are used in the creation of learning-object-based solutions. To learn more about implementing this classification, see the "Reusable Learning Object Authoring Guidelines v1.0" white paper.

The classification table lists the five types of topics and their definition. It also contains examples, sample titles, and sample learning objectives for each. While this table is a helpful reference, the Clark text provides more detailed explanations of each topic.

Type Matching and Samples

Type	Definition	Examples	Sample Titles	Sample Objectives
Concept	A group of objects, symbols, ideas, or events that are defined by a single word or term, share common features, and vary on irrelevant features.	Look for multiple examples of the class or group that share common features and are designated by a single word or term; for example: "user," "forms," "router," "needs," "requirements," "PSTN."	"What Is PSTN?" "What Is a Router?" "Where Is SONET/SDH Used in a Network?"	"Select any device that is not a router and describe which features led to your choice, given various networking devices"
Fact	Unique, specific information in the form of a statement or data or pictures of specific objects.	Look for unique specific information in the form of a statement, data, or picture of specific objects; for example, "setup script on the 2500 router," "number of card slots on a Catalyst 5500 switch."	"About Cisco 2500 Router Setup Script" "About Catalyst 5500 Slots" "About Footprint Size of the Cisco 7600 Router"	"List the number of slots found in the Catalyst 5500 switch"
Procedure	A sequence of steps to be followed by one individual to accomplish a task or make a decision. A procedure contains directions, tasks, or actions that are done the same way each time.	Look for directive steps, second-person language, active voice; for example, "how to log on to a computer."	"How to Log on to a Computer" "How to Access the Learning Content Development Pack"	"Successfully log on to a computer on the first attempt, given a computer and a network connection, login ID, and password"

Type	Definition	Examples	Sample Titles	Sample Objectives
Process	A flow of events that describes how something works. It is not necessarily a task done by one person, as many people or an organization may be involved.	Look for descriptive stages, third-person language, and passive voice; for example, "identifying data link layer problems."	"Identifying Common Physical and Data Link Layer Problem Resolutions" “Designing the Logical Campus Network” "Implementing the Product Development Cycle"	"Create an illustration of how a message is routed across a wide-area network using leased lines between the routers, from a collection of networking icons"
Principle	Directions for tasks that provide employees with guidelines for action. The guidelines must be adapted by the employees to various job situations. Principles require employees to use judgment and discretion when they apply them. Ask yourself these questions: Is the task completed in a different way each time? Does the outcome of the task rely on the circumstances and on the learner's judgment?	Look for guidelines, judgment calls; for example, "designing a multilayer switched network."	" Designing a Multilayer Switched Network" "Positioning the Catalyst 5500 Switch to IT Managers" "Handling Customer Objections"	"Describe the guidelines that were used in each, and any limitations that those designs may encounter, given a series of multilayer switched network diagrams"

Identify the Primary Learning Approach

Many critics of learning objects have expressed a concern that objects are implemented using a structured, controlled learning environment that tends toward a directive style of delivery or, worse, receptive page turning reminiscent of 1980s-era computer-based training (CBT). While these kinds of objects may be the easiest to create, learning objects support many approaches. The quality of any learning is mainly determined by the implementation of learning methodology, not the methodology itself. For example, the same learning objects could be delivered to support any of Dr. Ruth Clark's four architectures (approaches) of receptive, directive, guided discovery and exploratory learning. For a demonstration of this concept, refer to the ILSG white paper, "Enhancing the Learner Experience." The table below summarizes the four learning approaches.

Four Learning Approaches

Approach	Description
Receptive	Instruction is presented in a fixed, linear path from beginning to end. Learner control is often limited. The learner is forced to proceed at a predetermined pace and is expected to "absorb" information as it is presented, without rehearsal opportunities. Examples of this type of delivery include video training, lectures, or any environment where the learner cannot "skip around" in the course.
Directive	The path through the learning experience is suggested through a "learning path" which typically sequences the learning from easier to more complex. The learner is encouraged to use the course as designed, from start to finish, through a number of visual or audio cues. Frequently, practices are used to reinforce retention of knowledge and skills. Examples include books and web-based training where there is a "page-turning" approach to delivery. It may also be found in simple role-plays or simulations where the number of branches or choices for the learner is limited and little deviation is allowed.
Guided Discovery	Encourages the learner to explore a learning environment and complete problem solving. There is often a job scenario or problem presented to the learner to frame the exploration toward the discovery of new skills and knowledge. The learner is supported with the information required for solving a given problem. Examples of guided discovery applications include rich multimedia simulations, case studies, and scenarios where the learners solve problems or complete tasks as they would on the job.
Exploratory	Allows learners to search freely and "jump" into the content to find knowledge and information that meet their needs. Successful exploratory learning is based largely on the motivation of learners to find what they need to perform a skill or acquire new knowledge. Examples include surfing or researching a topic through the Internet, corporate information database, or library. Within limits, learners are free to do anything that they feel is necessary to meet their needs. The instruction provides navigational interfaces to allow the learner to maintain orientation without sacrificing learner control.

While a well-crafted and -implemented RLO strategy will support all four approaches listed here, it is important to start the Design and Mine phase off by identifying your primary learning approach. For example, if you decide to focus on a guided discovery learning experience, then the tools and resources that you need to author and deliver that solution are bound to be more sophisticated than those of a simple, directive architecture.

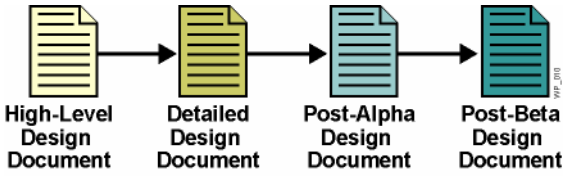
Sign Off on the Design

Traditionally, the Design and Mine stage ends with recognition that the design is complete, and that development of the learning experience can begin. The deliverable at the end of both the ADDIE and LOD process is some type of detail design document (DDD). This document tells both the stakeholders and those implementing the solution, what is being built, and its scope, media resources, target audience, objectives, cognitive type, and learning approach. While the scope and the number of learning objects contained in the DDD may vary from project to project, the need to have a sign-off by stakeholders and a road map, or blueprint, remains.

Within Cisco ILSG, a DDD is used to this end. It contains a number of details about the learning-object-based solution being created. In fact, the design document starts capturing information about practice types, content treatment, and metadata that will be used during development. During the remaining phases of the LOD process, the DDD is updated to reflect any changes that may affect the design. These changes each receive a sign-off as amendments to the original document (see the various revision cycles in the illustration). Keeping the DDD up-to-date during the LOD process ensures that when there are future updates or improvements to the learning object, there is a valid design document from which to start.

It is desirable to create an integrated design and development database that allows for the learning product design to be automated. Such a tool allows the author to move from the design phase to the development phase with or without a formal printed deliverable. In fact, given the granular nature of learning objects, it is possible to design and approve individual learning objects independently of the larger "course" structure that it may ultimately form. That being said, the formal design is still the single most important vehicle to foster accurate communication between the stakeholder and developer regarding the final form of the learning product.

ILSG's Design Document Life Cycle



Stage 3: Reuse and Develop

As in the traditional ADDIE model, this stage in the LOD process focuses on developing all the resources, content, and interactions for each learning object described in the DDD. In the LOD process, however, the primary change is the ability to reuse and repurpose existing materials such as existing learning objects. How substantial this change is depends on the tools, systems, and guidelines that you have in place.

The LOD process leverages learning-object-based authoring tools to create content, practice questions, assessments, media (sound, video, graphics), simulations, and labs. Each of these content types is stored as a learning object that has metadata and can be reused and repurposed in any learning architecture or delivery media. Assembly tools are then used to build structures (for example, a course hierarchy) from the stored objects.

Capture Metadata About Each Object

During the development of learning objects, it is important to include metadata (descriptive and relational information) about each learning object that is developed. Hopefully, some of the metadata was captured in the DDD from the previous stage in the LOD process. Other metadata should be captured and automatically maintained by the system (author, dates, media type, hierarchy, size, and so forth). This metadata work during Design and Mine can minimize the impact on the authors during the development phase, where they will need to capture only a few metadata values for each object. This specific metadata includes description, objective, title, owner, key words, competency, and so forth. Keep in mind that a learning object should be considered incomplete without metadata because most of the benefits of the RLO strategy would be lost without its use.

See Appendix C for examples of metadata and its application in the RLO strategy.

Utilize the Proper Authoring Tools

Over the past four years, a number of tools and systems have emerged to support a range of open and closed standards for building learning objects. Many tools today allow for SCORM 1.1 learning objects (called SCOs) to be created, imported, exported, and exchanged. Others have supported the authoring and assembly of learning objects into a database through rich markup languages such as extensible markup language (XML).

It is beyond the scope of this white paper to review these tools. Instead, the subject of authoring tools is presented to call attention to the fact that many of the benefits and challenges of an RLO strategy are tool-dependent. For example, an RLO strategy may require a tool that allows for collaboration between authors, has a metadata-rich database, and allows for workflow management, change notification, and ownership rights and privileges. Additionally, the authoring tool may need to support the final publishing of learning objects as ILT materials, e-learning, help systems, or handheld PDAs.

At Cisco, a variety of tools are used to create the diverse learning experiences offered to employees. Some tools are designed specifically to fit the requirements of the RLO strategy, while others are traditional tools such as Microsoft Word and PowerPoint. There are many tools on the market that perform these types of functions. As you move forward, keep in mind that a combination of tools will likely be used to support an RLO strategy.

Account for Equivalent Objects

One important consideration when you are developing learning objects is the need to manage equivalent objects. While all the other development tasks are critical, you should keep in mind that the course, module, lesson, or topic may have secondary, mirrored objects in the database. These equivalent objects are based on the same learning objective as their source, and appear at the same level in the hierarchy, based on metadata. The difference is that they differ in media type, media quality, learning modes, language, or localization.

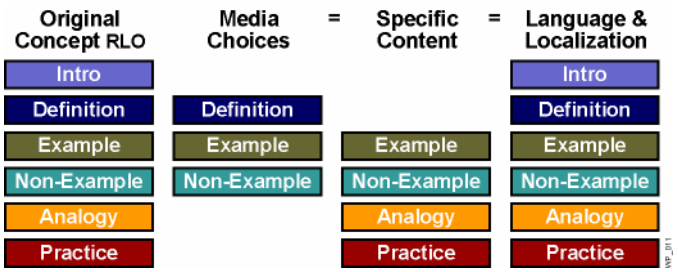
The figure shows how media choices, specific content, and language and localization may be “added” to a learning object. Below each heading a number of subtopics have been added as needed to the original RLO.

Media quality, for example, may include a low-resolution image for the web and a high-resolution image for print. Learning mode and media type can be used to present text, audio, and video for a definition, example, or procedure. Finally, language and localized content for an analogy or case study could be built to support the globalization of a course.

Notice that for language and localization, the entire learning object has been replaced in the figure; however, you may find that only some parts of a learning object need to be replaced based on your business rules or budget. Regardless of what is added as an equivalency, the logical link to the original learning object learning objective is maintained.

Note that this important requirement is often missing from authoring, content management, and delivery systems. It is, however, something that authors and systems architects should keep in mind when building objects for diverse global learners.

Equivalent Learning Objects



Keep in mind that if the source object is changed or retired, change notifications should go out to the authors and learners who rely on that object. Learners will want to know that a new version of a learning object that they already completed has been updated and where to locate the new version. Authors will want to know about a learning object change that may affect a course in which they use that learning object.

Stage 4: Delivery and Reference

Once development is complete, the learning objects are made ready in a delivery environment as a learning experience. The learner experience can include, for example, an instructor-led course, training website, virtual classroom event, and job aid. The key difference between the ADDIE process and LOD process is the idea that a learning object is accessible over time. This shift of emphasis in the LOD scenario reflects the fact that a learning ecosystem supports knowledge and skills transfer far beyond traditional events that are scheduled in time (such as a class).

The learner now has access to training, information, collaboration, and communication environments. This access is integrated as closely as possible into the work setting. The learning materials are generated from a database of learning objects and presented to the learner in one of the four learning architectures.

Compare this stage in the LOD process to the traditional way of implementing a training solution with the ADDIE model. A traditional ILT event meets at scheduled times. In the LOD process, a sophisticated learning-object-based delivery system opens up the possibility that the same learning object can support flexible, on-demand training as part of a problem-based learning event or a simulation, or as a performance-support tool.

Ideally, how learning objects are delivered is based on the preference of the learner. If an object exists in multiple delivery media, learners are free to choose the medium that best matches their learning style, metacognition, and available time. For example, learners may access some time-critical objects at their desk via the web, at the time of need, while they save a group of objects for a live instructor-led class being held a week later.

Common types of delivery include:

- Dynamic
- Static
- ILT materials
- Other media (PDAs, MP3 audio players)
- Virtual and remote classrooms
- Blended learning events (combining some or all of the above)

Dynamic Delivery

In this case, objects are built as needed and delivered to learners through a web browser as they are requested. When learners want to take a lesson or to reference a job aid, they simply request the learning object from the database. Format and style sheets are then applied to the objects as they are packaged and delivered to the learners' browsers.

Static Delivery

In cases where the learner is separated from a network connection, due to travel or other physical constraints, the learning object and its assets can be packaged onto a physical medium. Static objects of any size (course, lesson, topic) should have as much dynamic functionality as possible. They are simply written onto a physical medium at the time that the request is made by the learner (just-in-time) to be accessed later as needed. Another choice is to provide a catalog of prepackaged media (such as CD-ROMs); however, this activity can lead the learner to take outdated training if the inventory in the catalog is not current.

Instructor-Led Training

The need for live ILT will not diminish because of the availability of e-learning. The RLO strategy supports the creation of ILT materials such as learner workbooks, instructor guides, learning activities, and presentation materials. Learning objects and their assets are stored free of format and style, and therefore can be repackaged using style sheets and templates specific for ILT delivery. Some of this repackaging may be manual, depending on the tools and systems that you use in creating your learning objects.

Other Delivery Types

In addition to the delivery types described in the preceding sections, PDAs, MP3 players, virtual classrooms, and blended or combined delivery are all relevant delivery options in the RLO strategy. Keep in mind that some media elements may not play in every delivery type. For example, some PDAs do not support animations or audio files, and MP3s require audio for each object. Equivalent objects could be created and tagged through metadata to ensure the broadest range of delivery options.

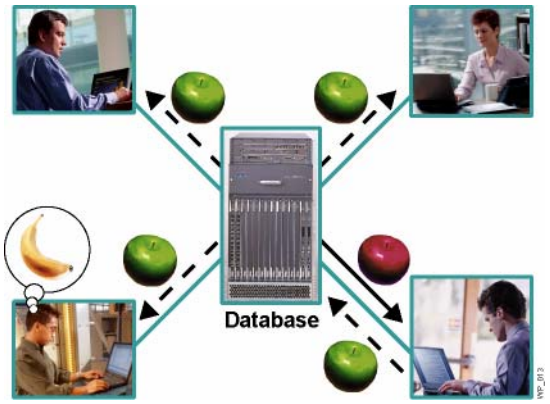
Stage 5: Maintain for Life

Once a learning object is made available to the learner, it is usually updated and maintained for its entire "life span." The idea of maintaining and updating content, training, and learning is not new, and many of the challenges that you face today with keeping your content current will still remain even with a move to learning objects. In fact, learning objects that are stored in a common database, allowing multiple authors to share them, and present them via multiple delivery options to various learners, present particular business and system challenges.

With the proper tools, an author may change part of a learning object and then republish it so that a learner can access the change. Ideally, the learner would be notified that the update has been made, and directed to the specific change instead of repeating the entire course or lesson that contains the updated learning object. This process becomes more complex when an author updates a learning object that is shared in multiple learning experiences, is being accessed by multiple learners, or is delivered in help systems, e-learning, or ILT programs.

The figure shows four authors working on a common learning object, in this case a piece of fruit. One author changes the original red apple to a green apple. Because each author has reused, or linked to, that same learning object, the change in color is applied to all learning experiences using that red apple. Now each has a green apple in their learning object. Likewise, if another author decides to change the type of fruit to, say, a banana, then that change would affect everyone who has agreed to accept changes without review. With the proper authoring tools in place, however, authors would receive an alert that a change is being proposed, giving them a chance to accept or reject the change. In the absence of such tools, businesses would need to establish special rules and guidelines around the issues of repurposing and ownership rights.

Impact of Reuse and Edits on Authors and Learners



A business rule may be established to simply have authors repurpose the original object and not impact the other authors. Instead of trying to change the color of the apple, the author could elect to repurpose the original learning object and make a new object in the database to house the banana learning object. This option breaks any dependencies with the original. Whether you are directly reusing or repurposing learning objects, business rules around reuse, repurposing, editing, change notification, and ownership need to be established.

At some point, a learning object may become obsolete, and you will want to remove it from the database or make it inaccessible to authors and learners. Accomplishing this goal will be more complex than ending the life of a traditional course or an e-learning program. For example, a learner may have used that learning object as part of a job aid or has downloaded a local version to a desktop or digital assistant for future reference.

As part of this process, an object owner might want to retire a learning object that is being used by other authors in other parts of the learning object database. In our previous example, the owner of the green apple may decide that it's time to delete that learning object from the database. Everyone linking to that learning object could have that learning object deleted from their courses depending on the business rules and tools used for ending a learning object's life.

At Each Stage: Evaluate

As in the traditional ADDIE model, the LOD process calls for evaluating the learning experience. An evaluation can be used either to make improvements to the process itself, or to evaluate the impact of the learning experience. Regardless of how you use evaluations, your organization's goals in conducting evaluations should remain the same once you adopt an RLO strategy. In other words, the challenges that you now face with creating valid and effective evaluations still exist when you adopt learning objects.

One change between these processes, however, is when to conduct the evaluation. Often we find that there might not be a formal event completion in those delivery media to trigger the evaluation. When learners "start" the learning experience, there is no guarantee that they will touch on each available learning object in order to trigger an evaluation from the delivery system. From the perspective of the learners, having a new evaluation for every learning object that they access could become annoying. Therefore, deciding when and where to conduct evaluations is up to your business to define carefully.

In general, evaluations can be performed at four levels (Kirkpatrick, 1996). These levels are summarized as follows:

1. Learner satisfaction with the learning experience
2. Measurable learning at the end of the learning experience, based on the learning objectives
3. Transfer of learning back to the job after the learning experience (explores what knowledge and skills have "stuck" with the learner after some period of time)
4. Impact on the business as a direct result of the learning experience (based on metric such as costs, time, errors, and so on)

Each level has its benefits in what it can tell the author and organization about the effectiveness of a training intervention. While these four levels are not specific to an RLO strategy, they are important to the organizations that need to repurpose or reuse objects while at the same time ensuring that the objects meet the diverse needs of the learner and business.

Conclusion

This latest version of the RLO strategy demonstrates one method that Cisco uses to create and support rich learning experiences for its employees. This white paper presents many of the ideal features and functions found in a learning object strategy, based on the lessons learned over the past four years since Cisco published the first draft of the RLO strategy.

This version refined the development process, and expanded the view of how learning objects are used to encompass problem-based learning, guided discovery, and other learning approaches. This white paper expressed many of the challenges facing any organization adopting a learning object strategy, and may serve as a road map for anyone implementing a similar RLO strategy in their organization.

While this paper is more complete than its predecessor, it is not the end of the story. Look for future versions of the RLO strategy to document more approaches to learning, provide richer case studies and examples, and reflect on Cisco's growth in supporting its learning ecosystem.

Further Reading

It is recommended that you also review the other white papers that represent Cisco's learning ecosystem. Two companion documents to this "RLO Strategy" white paper are the "Reusable Learning Object Authoring Guidelines" and "Enhancing the Learner Experience" white papers. It may also be helpful to look at Cisco's learning architecture documents that describe the systems that must interact together to enable the RLO strategy and learner experience, and that enable employees to gather information, and facilitate communication and collaboration. Each of these documents can be found at Cisco.com.

In addition, this document contains three appendices with information that is key to any learning object strategy, but may be referenced separately as your needs or interest dictate. They include information about practices and assessments, standards and specifications, and metadata.

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World Wide Web Links

- Advanced Distributed Learning. http://www.adlnet.org/index.cfm?flashplugin=1&fuseaction=home
- Aviation Industry CBT Committee. http://www.aicc.org
- Cisco Systems, Inc. http://business.cisco.com/prod/tree.taf%3Fasset_id=44748&public_view=true&kbns=1.html
- Clark Training & Consulting. http://www.clarktraining.com/
- IMS Project. http://www.imsproject.org/
- Learnativity.com. http://www.learnativity.com/

Appendix A: Practice and Assessment

At Cisco, a learning object is defined as containing content, interactivity, and metadata. In addition, each learning object has a learning objective and therefore an associated learning activity, practice, and assessment to ensure that new skills and knowledge are mastered.

Different practice and assessment methods can be employed to engage the learner, ranging from interactive media-rich content to formal practices with instructional feedback depending on the learner's selection. The type of practice being used depends on the learning approach being applied (receptive, directive, guided discovery, or exploratory) and the delivery medium being used (self-paced e-learning, virtual classroom, help system, instructor-led, or blended solutions).

The number of interactions and practices that the learner needs for each learning object in order for skills and knowledge to transfer from the training arena to the workplace depends on the background of the learner, the cognitive level of the learning objective, the type of media being used in the delivery, and the level of the course hierarchy that it is mapped against.

While these subjects can be addressed in great detail, we'll simply highlight some of the issues and concerns you may want to address when creating practices and assessments using an RLO strategy.

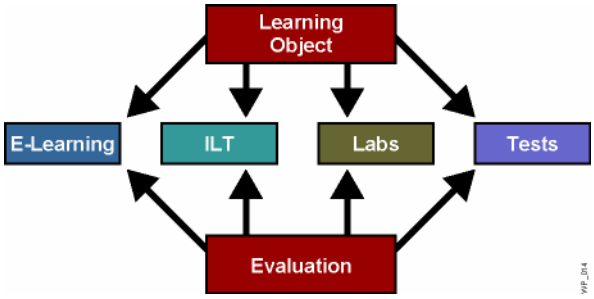
Media Independence and Delivery

Practice and assessment items, ideally, are created so they can be delivered in any medium. The ultimate goal is to author once and deliver in many learning environments without changing the practice. For example, a practice designed for ILT would work for an e-learning course. In reality, however, the elements, or even the interaction between the instructor and learner, or computer and student, would need to be unique to a particular medium.

A computer-based simulation may be effective for e-learning, while live equipment can be used in the classroom. In some cases, especially when it comes to certification, a proctored assessment may be required. In other cases, direct observation may be needed to assess learner performance of a skill on the job.

Notice, however, that the learning objective for a practice stays the same, even if the exact interaction or media that supports that practice needs to change to accommodate a delivery medium. This situation again brings up the idea that your most significant reuse may occur during the design of the learning environment (see figure).

Creating Multiple Solutions from one Learning Object



During the design phase, a common set of learning objectives are created. Each learning objective could spawn a separate learning environment supported by a different learning approach (receptive, directive, guided discovery, exploratory). Each option found under that learning objective might have common content and practice and assessment assets, with specific differences for the media or interactions for that learning environment or learning approach.

Creating Practices

A practice item is any reinforcement activity that gives the learner the opportunity to apply skills and knowledge. Often the system provides mentoring and feedback. Performance may or may not affect the overall assessment of the learner. Practice activities can take on many forms, including case studies, role playing, simulations, games, quizzes, and lab exercises.

Practice items provide learners with a way to assess their own learning prior to attempting a scored assessment. Practices also engage the learner during self-paced learning. Without practice items for each topic, the potential of the topic itself to produce the desired learning outcome would most likely be reduced for self-paced delivery. In addition, there would probably be a drop in the motivation or interest of the learner to complete the topic.

Objective and Cognitive Level

During the design phase, a learning objective is written for each topic, and a cognitive level is assigned to the topic based on that learning objective.

It is important that the practice item match the objective and cognitive level. For example, if a topic objective makes the goal of the learner to "list the five commands used to configure an access list," with a "Remember: Knowledge" cognitive level, then the practice item should help the learner memorize the five commands.

Likewise, if the objective makes the goal of the learner to "correctly configure an access list using no more than five commands" with a "Use: Application" cognitive level, then the practice items should give learners a hands-on activity so they can practice the skill of entering the correct configuration.

Types of Practices

There are hundreds of possible practice items, or learning activities, that an author may want to use. However, there are reasons to limit the number of activities that an author is allowed to use. These reasons may include delivery media, time to develop, time to administer, and so on.

While all the objects that support the RLO strategy are designed to be delivery-media-independent, some practice items may not work in all delivery formats. For example, in an instructor-led course, a valid practice is to have learners form small groups to work on an assignment. For a self-paced, web experience, a similar practice may not be possible, and therefore an alternative practice would be created for this topic.

Examples of practice items include:

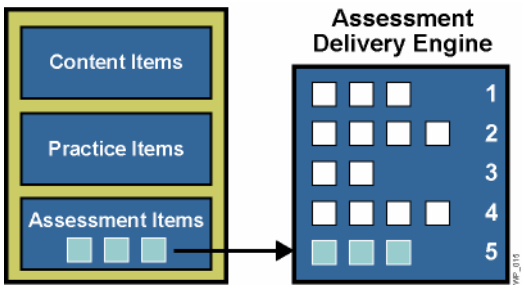
- Matching (multiple choice, true/false)
- Text entry
- Simulations
- Case studies
- Role playing
- Games
- Hands-on lab exercises (remote or local)

This list does not include all the methods that you may use to delivery a practice item (for example, flash cards, chalk talks, small group activity, and mentor sessions) and so will be supplemented as Cisco development and delivery systems mature.

Creating Assessments

The author writes a pool of assessment items for each learning object. The pool is then made available to the learner as an assessment. Based on the result of that assessment, the learner is pointed to the correct learning object to review. If required, the delivery engine records the score of the learner and reports that data to the management system.

Assessment Items from Learning Object Create the Assessment



A large pool of questions is best in order to allow the learner to "test out" of lessons. As a result, learning objects can be "prescribed" to learners based on their assessment results. The individual items in that pool must also be valid. It is beyond the scope of this document to discuss validity as part of assessment creation. The point for the RLO strategy is that each learning object has an associated assessment item, allowing for the possibility of prescriptive learning.

Prescriptive Learning

When the learner takes an assessment before starting a course, module, or lesson, it functions as a prescriptive tool. The assessment evaluates whether the learner meets the objective of each smaller object found in the hierarchy.

If the learner passes the assessment, there is no need to take the related course, module, or lesson, because the learner has earned credit for all the knowledge and skills covered by this material.

If the learner fails any item in the assessment, the learner will then be prescribed the learning objects associated with each missed assessment item. This specificity is possible because each assessment item is mapped to a specific learning objective.

When an assessment is taken after a course, module, or lesson, it functions as a mastery assessment. Learners who pass the assessment are told that they have successfully completed the entire lesson, module, or course and have earned credit for all related learning objectives, knowledge, and skills. Learners who fail part of the assessment are told which learning objects to review as a prescription.

Appendix B: Standards and Specifications

Throughout this document a number of standards and specifications groups have been mentioned. Most notable are the IEEE, Instructional Management Systems (IMS), and ADL. Each has a specific purpose in defining e-learning specifications that relate to learning objects, metadata, and the communications between systems and tools. While it is beyond the scope of this document to present a detailed analysis of each, we would like to acknowledge how they fit within the RLO strategy, how Cisco participates in these groups, and how they impact future learning object implementation.

IEEE LTSC

The IEEE Learning Technology Standards Committee (LTSC) is the group within the IEEE that published the first real industry standard for e-learning, the Learning Object Metadata (LOM) standard (http://grouper.ieee.org/groups/ltsc/index.html). The 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.

As mentioned in the section of this document on metadata, Cisco has adopted the LOM standard published by the LTSC, extending its vocabulary to fit our specific business needs.

Instead of working directly with the IEEE, Cisco Systems has chosen to work with the IMS Global Learning Consortium (described in the next section) as a voting technical board member. This has proven effective, as the IMS metadata sub-group publishes updates to the metadata specification based on industry application of the IEEE standards and then promotes those to the IEEE. The IEEE can then choose to update their standard to reflect the recommendation from the IMS.

IMS Global Learning Consortium

IMS Global Learning Consortium, Inc. (www.imsproject.org) 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.

The two primary goals of the IMS are as follows:

- Defining the technical specifications for interoperability of applications and services in distributed learning.
- 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”).’

As a contributing member to the IMS, Cisco Systems is a voting member of the technical board of companies, organizations, and educational institutions that form the consortium. Cisco has many resources dedicated to active participation in the many workgroups within the IMS. Each workgroup addresses a specific need within the IMS and works collaboratively with the other members to define industry specifications that fit the IMS charter and the needs of the members.

Once an IMS specification is approved by the technical board, the public is free to review and adopt that specification in their environment. Often, the IMS will “hand off” a specification to the ADL (see next section) to help fill out its sharable content object reference model (SCORM). If the ADL and IMS members use a specification over time, it may become a de facto standard that is promoted to an accredited standards board like the IEEE. This is similar to the process that the LOM followed as it moved from the IMS to ADL and through the IEEE.

ADL and SCORM

The United States Department of Defense (DoD) formed a group called the Advanced Distributed Learning (ADL) initiative (www.ADLnet.org). This group was set up to ensure access to high-quality education and training materials that can be tailored to individual learner needs and made available at any time and in any place. It has developed guidelines for development and implementation of efficient and effective distributed learning, stimulated large-scale collaboration to share requirements, and accelerated the development of a robust, highly diverse, object-oriented, open environment. Its website offers three things that Cisco and other organizations leverage in their own e-learning development: the SCORM specification, examples mapping to the SCORM specification, and applications to test for SCORM compliance.

SCORM serves the following functions:

- Creates a reference model that defines a web-based learning "content model"
- Provides a set of interrelated technical specifications
- Bridges the gap from general emerging technologies to commercial implementations

While the ADL is a government agency, it does invite interested software vendors and those implementing e-learning to its regular meetings, known as Plug-Fests, where updates to the SCORM document are presented, tool vendors demonstrate compliance, and learning object vendors exchange and manage content. Cisco attends these events on a regular basis, and stays informed on updates to the specification. Cisco does not have an interest in the marketing and sales of its internal e-learning tools, as do other companies that participate in Plug-Fests. Other vendors have a vested interest in being as SCORM complaint as possible to ensure sales to customers who demand compliance. Instead Cisco's participation in the Plug-Fests represents a corporation with a large amount of content to share between computer systems and a select group of external training partners.

AICC

Aviation Industry CBT (Computer-Based Training) Committee (AICC; www.aicc.org) has published many guidelines focused on development, delivery, and evaluation of CBT and related training technologies. While the group is focused on the aviation industry, its work has been recognized by many other standards groups. For example, the AICC's guidelines for managing e-learning, passing test scores, and completion data, and adding metadata to e-learning have all been used to some extent to inform other specifications.

The primary goals of the AICC:

- Assist airplane operators in guidelines that promote the economic and effective implementation of CBT
- Develop guidelines to enable interoperability
- Provide a forum for discussion of CBT and other training technologies
- Promote interoperability standards that software vendors can use across multiple industriesCisco is not directly involved in the AICC but is informed on emerging guidelines from this group as a result of its ongoing involvement in both the IMS and ADL, given that all these groups share information with each other and leverage best practices.

Appendix C: Applying Metadata

Metadata is historically defined as data about data. Simply stated, metadata is information that describes a learning object. Metadata can be used to describe any size of learning object, regardless of its placement in a course hierarchy, or with a learning approach. In fact, metadata could actually be used to describe a learning object's placement and approach, among other critical information.

Metadata is the key to driving the learner-centric experience. Tagging content with metadata enables dynamic personalization of content; thus, learners are able to locate what they want to see, and determine how they want to see it. Metadata also facilitates content mining across learning groups. Learning content that is tagged with metadata aids in identifying and locating content for reuse. In other words, it allows authors to be able to search out learning objects that fit their specific criteria, and then use those in their training solutions. Therefore, the process of tagging content enables many of the benefits of adopting an RLO strategy.

Examples

In order to look up a book in a library, you may use a physical "card" catalog that is usually stored in a cabinet. The cards contain a great deal of metadata about the books in the library. Each piece of information on the card is a piece of metadata telling you about the subject, publish date, author, and related titles. Computerized card catalogs allow even more data about the book, such as descriptions and links to other works by this author, in the same subject area.

Another example of metadata is the label on a candy bar. From the label you know the type of candy bar, its brand, manufacturer, expiration date, quality/marketing statement, ingredients, and nutritional facts.

Cisco's Use of Metadata

The previous examples are quite simple when compared to all the possible metadata tags that are defined by the industry. Within Cisco, a great deal of research, trial and error, and use cases have been applied to determine the "right" mix of metadata that will benefit the author and the learner. Cisco has put into place systems and tools for capturing and using metadata about both learning objects and traditional courses. To ensure that Cisco's metadata meets all internal needs, and reflects industry standards such as the LOM from the IEEE, Cisco has formed a cross-functional Metadata Framework (MDF) committee.

Not all the metadata captured at Cisco is specific to learning objects. In fact, the document-publishing group has guidelines, approved by the MDF, for what metadata gets applied to each document. Likewise, metadata is entered by anyone who publishes presentation slides with video/audio to the Cisco video on demand (VoD) repository. Even the design document used in ILSG at Cisco captures metadata that will ultimately be used by authors during the learning object's development, and by learners upon its completion.

The list below is a sampling of some of the metadata tags used at Cisco.

- Job Role
- Language
- Content Owner
- Delivery Type
- Release Date
- Cisco Internal Searchable
- Cisco Products
- Cisco Technologies
- Cisco Networking Solutions
- Cisco Business Solutions

Ideally, these values are captured at each level of a course hierarchy, from the largest learning object container (for example, “Course”) down to the smallest asset (for example, graphic). However, compromises may be made on how much metadata is captured at each level before the cost of entering the metadata outweighs the benefits for authors and learners. Like Cisco, each business must determine what the “right” balance of metadata is for their organizational goals.

Metadata Standards

The IEEE LOM P1484.12 (http://ltsc.ieee.org/) is the first standard for learning objects. This standard defines a number of metadata fields and values that you can apply, or tag, to your learning objects. Many of the metadata fields listed in LOM P1484.12 are optional, saving the author from having to capture every one. The table lists the LOM categories and values that an organization may implement.

LOM Categories and Values

LOM Category	LOM Value
General	1.2 Title 1.3 Language 1.4 Description 1.5 Keyword
Life Cycle	2.1 Version 2.2 Status
Meta-Metadata	3.3 Metadata scheme 3.4 Language
Technical	4.1 Format 4.2 Size 4.3 Location 4.7 Duration
Educational	5.1 Interactivity type 5.2 Learning resource type 5.3 Interactivity level 5.8 Difficulty
Rights	6.1 Cost 6.2 Copyright
Relation	7.1 Kind 7.2 Resource
Annotation	8.1 Entity 8.2 Date 8.3 Description

Extending Metadata Through CLEO

The Customized Learning Experience Online (CLEO) Lab (http://www.cleolab.org/) was a one-year research collaboration between academic researchers, corporations interested in e-learning, and the ADL. Founded by Cisco Systems, Click2Learn, IBM Mindspan Solutions, Microsoft, and Thomson-NETg, the CLEO Lab aims to conduct focused, applied research on technical and pedagogical issues related to the ADL SCORM, an important compilation of e-learning interoperability specifications.

The CLEO Lab produced a document that extends the metadata defined by the IEEE 1484.12.1-2002 LOM. The LOM standard defines many data elements that may be used to characterize learning-related content. Communities of practice adopt the LOM standard to their specific requirements by creating profiles. Through the member participation, which includes Cisco, the CLEO Lab created and documented a profile to facilitate interorganizational exchange of business-oriented learning content.

The table below summarizes the profile, or, more generically, the extensions and modifications made to the IEEE LOM. For a detailed explanation each change and addition to the LOM, please refer to the CLEO Lab website.

CLEO Lab's Extensions and Changes to the IEEE LOM

Number	Name	Definition	CLEO Changed
1.8.1	Aggregation Sub Level	Identifies the aggregation hierarchy level of the content at a deeper level than with the LOM vocabulary	Added this as an extension to the LOM
5.2	Learning Resource Type	Identifies the instructional purpose of the object	Defined a vocabulary to use with this existing field
5.9.1	Typical Learning Time Range	Identifies the approximate or typical length of time (range) that it takes to work with or through this learning object for the typical intended target audience	Added this as an extension to the LOM
5.12	Cognitive Domain	Identifies the cognitive level	Added this as an extension to the LOM
5.13	Cognitive Strategy	Identifies the cognitive strategy used in conjunction with Cognitive Domain and Learning Resource Type	Added this as an extension to the LOM
9.1	Purpose	Extends purpose to include vocabulary to identify business purpose	Added this as an extension to the LOM

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