

Choosing a Learning Management System



Advanced Distributed Learning (ADL) Initiative

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4 November 2016
Version 8.0



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NOTE: Vendor citations or descriptions in this paper are for illustrative purposes and do not constitute an endorsement by ADL. All listings of vendors and products are in alphabetical order unless otherwise noted.

1. Purpose and scope of this paper

The purpose of this paper is to help those involved in the process of choosing a learning management system (LMS) to make an informed decision. This applies to choosing an LMS for the first time, where none was already in place, and replacing an existing LMS. The paper presents a range of considerations for choosing a system; it does not contain a comprehensive survey of all available systems on the market, nor does it contain a comparative rating or evaluation of products, and should not be construed as such. For more in-depth information about systems and their features, see the references in *10 References cited in this paper* or consult the vendors. ADL presents this paper merely as a guide to the issues, opportunities, and processes that should be considered in choosing a system.

Although this paper is focused on LMSs, we give some consideration to the broader scope of learning-related systems: course management systems (CrMSs), talent management systems (TMSs), learning content management systems (LCMSs), and virtual learning environments (VLEs). You must account for these in the process of choosing a system to manage and deliver your learning, since you must first determine the high-level, basic functionality you need; if you need your system to manage instructor-led training classes, or include authoring capabilities, one of these systems might be a better choice than an LMS. (We must issue an important caveat here: the capabilities of these systems are merging into each other and with LMSs; the category labels and distinctions are becoming less meaningful in many cases.) In an effort to include the total decision process and options available, we present high-level descriptions of these categories of systems in this paper, although we are mainly focused on systems that are designed to deliver and manage asynchronous eLearning (this is the traditional scope of LMSs).

In line with our mission to promote reusability and interoperability in eLearning, ADL recommends systems with built-in features that allow managing and delivering SCORM®-conformant eLearning. Acquiring a system that does not support eLearning that is interoperable or reusable can be a significant business risk. You can find SCORM considerations for LMSs in 4.15.1 *SCORM*.

2. Overview

2.1 What is an LMS?

The Learning Systems Architecture Lab at Carnegie Mellon states that, “A Learning Management System (LMS) is a software package used to administer one or more courses to one or more learners. An LMS is typically a web-based system that allows learners to authenticate themselves, register for courses, complete courses and take assessments” (LSAL, 2004 in Gallagher, 2007).

Expanding on this definition, LMSs can be described as enterprise level, server-based software systems used to manage and deliver (through a web browser) learning of many types, particularly asynchronous eLearning. They generally also include the capability of tracking and managing many kinds of learner data, especially that of learner performance. Many training organizations rely on their LMS as a single point of access for all their eLearning content and learner records. They are a key enabling technology for “anytime, anywhere” access to learning content and administration. Some systems (LCMSs) combine the above capabilities with authoring and content repository functions. In some LCMSs, you can decouple the authoring tool or content repository components and use them as separate applications without relying on the LMS component of the system. See 3.2 *Specialized LMSs* for more details. Authoring tool

functionality is covered in a separate ADL paper *Choosing Authoring Tools* (available at <http://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAuthoringTools.docx>).

Other categories of systems that are related to LMSs are covered in 3 *Categories of systems to deliver and manage learning*. As described in 1 *Purpose and scope of this paper*, it is important to understand the functions these provide in order to be able to precisely address your requirements; an LMS (defined in the sense we define it here) might not actually be what you need.

You need to be careful also about the term “LMS.” Industry professionals sometimes use it loosely to describe the other categories of systems described in 3 *Categories of systems to deliver and manage learning*. While it is true that the lines between these systems are becoming more and more blurred as these other categories of systems add LMS functionalities and vice versa, it is important to determine and use the most appropriate label for a system according to its primary use and market, in order to avoid confusion. These other categories of systems are designed for different sets of learning functions than a standard LMS.

Also, it is important to understand the difference between an LMS and an LRS. A Learning Record Store (LRS) is a specialized system used for storing Experience API (xAPI) data only. LRSs do not purport to cover the myriad of functions that an LMS covers. An LMS can actually include a built-in LRS, and an LRS product could include some LMS functions, but these systems are fundamentally not the same. LRSs are covered in a separate ADL paper *Choosing an LRS* (available at <https://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAnLRS.docx>).

The following general functions are normally provided by an LMS:

- **Structure** – centralization and organization of all learning-related functions into one system, enabling efficient access to these functions via layered interface navigation functions.
- **Security** – protection from unauthorized access to learning content, learner records, and administrative functions.
- **Registration** – finding and selecting or assigning courses, curricula, etc. by learners and their supervisors. This may include instructor-led training classes.
- **Delivery** – on-demand delivery of learning content and learning experiences to learners.
- **Interaction** – learner interaction with the content and communication between learners, instructors, and course administrators, as well as communication between the content and the LMS (e.g., SCORM content).
- **Assessment** – administering assessments and the collection, tracking, and storing of assessment results data, with further actions taken (possibly in other systems) based on the results of assessment. Many LMSs include the ability to create assessments as well.
- **Tracking** – tracking of learner data including progress on a predefined set of training goals and requirements, and tracking of courses for usage, especially in relation to required deployment of mandated training (for example, compliance training).
- **Reporting** – extraction and presentation of information by administrators and stakeholders about learners and courses, including the information that is tracked as described above.
- **Record keeping** – storage and maintenance of data about learners. This includes both demographic info that profiles learners and the training progress and accomplishments of learners. This is especially critical when an LMS is deployed as the official “system of record” for an organization.

- **Facilitating Reuse** – searching and recombining courses and possibly parts of courses for delivery in different curricula and learning tracks (this is a much more prominent feature of LCMSs, but is often included in an LMS).
- **Personalization** – configuration of LMS functions, interfaces, and features by learners and administrators to match personal preferences, organizational needs, etc. In advanced systems, “personalization” can also include tailoring of content or learning experiences to address the learner’s assessed or detected learning needs.
- **Integration** – exchange of data with external systems to facilitate enterprise-wide tracking of learner performance and transfer of user data, and to exploit external content and learning resources (i.e. content management systems).
- **Administration** – centralized management all of the functions in this list.

Added to the above general functions, in the most comprehensive of LMSs (especially ones that incorporate functions of other categories of systems—see *3 Categories of systems to deliver and manage learning*), one may find tools such as competency management, skills-gap analysis (Gilhooly, 2001), succession planning, certifications, virtual live classes, and resource allocation (venues, rooms, textbooks, and instructors).

Bailey in Watson & Watson (2007) presents general characteristics of LMSs in education that include:

- Tying instructional objectives to individual lessons
- Incorporating lessons into the standardized curriculum
- Extending courseware several grade levels consistently
- Providing a management system
- Collecting the results of learner performance
- Providing lessons based on the individual learner’s learning progress.

Further functionality is defined by the American Society of Training and Development (ASTD, 2008) as:

- Enabling integration with the human resources system or student information system (SIS)
- Incorporating tools to manage registrations, curricula, certifications, budgeting, and scheduling
- Providing access to content delivery
- Enabling content development, including authoring, managing and storing
- Integrating content with third-party courseware
- Assessing learners’ competency gaps
- Supporting assessment authoring
- Adhering to standards
- Supporting configuration to function with existing systems and processes
- Providing data security

LMSs are typically designed for multiple publishers and content providers and usually do not include their own authoring capabilities (that qualifies a system as an LCMS – see *3.2 Specialized LMSs*). Their main focus instead is on managing and delivering content created from a variety of sources (Hall, 2002).

2.2 How widely are LMSs used?

As an overall measure of the popularity of LMSs, Bersin (2014) has reported that the LMS market is well over \$2.5 billion and grew by over 21% in 2014. Hougan (2015) cites research from Markets and Markets indicating that the market will grow to nearly \$8 billion by 2018. Upside Learning (2016) supports this figure by predicting that "...between the years 2017 and 2018, the LMS market will grow by about 23.17%, with an estimate of growth from \$2.65 billion in 2013 to \$7.8 billion in 2018, which is roughly an annual growth rate of 25.2%." A large contributor to this growth, they say, is the uptake of LMSs by small and medium businesses.

In higher education, Brown et al (2015) report that "Estimates of institutions running an LMS are almost always near 99%. According to the first ECAR survey of faculty and IT, 85% of faculty use an LMS (with 56% using it on a daily basis), and 74% say it is a useful tool to enhance teaching. Among students, 83% use an LMS, and 56% say they use it in most or all courses." (p. 2)

According to a survey conducted by *Elearning!* magazine (Roche & Upton, 2013), 89% of the corporate sector are using an LMS, and 63% use an LCMS. Brandon-Hall (2012) reports that over 78% of organizations in their 2012 survey reported using an LMS.

2.3 What are the benefits of using an LMS?

If eLearning is already being used in your organization, though not delivered and managed through an LMS, the benefits of using an LMS derive mostly from the automation and centralization of functions that accrue from adopting almost any enterprise system. LMSs have been attributed as having the following benefits as well:

- Reducing costs through decreased training redundancy and reduced operational errors and down-time
- Maximizing efficiency through the integration of content delivery, reducing complexity and costs of auditing
- Leveraging existing resources by including established policies and procedures; utilizing existing training material and links to "off-the-shelf" commercial computer-based courseware (Szabo & Flesher, 2002)

If an LMS is being used to enable a switch from classroom instructor-led training (ILT) to eLearning in your organization, the following benefits can be expected from this switch to eLearning (delivered and managed by an LMS):

- **Time and location flexibility**
 - ELearning can be delivered to a student at any time and any location worldwide (where there is a computer on a network).
- **Language flexibility**
 - ELearning can be designed to support multiple languages.
- **Scale of delivery**
 - Thousands of students can take a single eLearning course at the same time.
- **Cost savings**
 - "Rule of Thirds" (Fletcher and Foster, 2002): Elearning can reduce costs by one-third and additionally either reduce the time to achieve instructional objectives by one-third or increase achievement (holding time constant) by one-third.

- No instructor is needed.
- No classroom facilities are needed.
- No printed materials need to be created or shipped out.
- **Flexibility in updating, adapting, and configuring eLearning software**
 - eLearning content can be updated and deployed on an LMS immediately.
 - Policies can be established to control access to content. LMS administrators can then control who sees what, using permissions settings.
 - Different content can be delivered to individual students according to characteristics in their user profile (their job role, for instance).
- **Training standards and uniformity**
 - ELearning can enforce standards and uniformity in training. It ensures that everyone gets the same information in the same way. There are no differences due to differences in instructor styles, knowledge, or preferences.
 - Elearning can be designed so that information can be updated in multiple content objects from one source. In other words, course authors can make a change to information in a content object or database, and that change is automatically made everywhere that information appears (in multiple objects).
- **Self-paced and just-for-me learning**
 - Content can adapt dynamically to the student's preferences and learning needs (using SCORM sequencing, for instance). Assessments can evaluate the student's level of knowledge and learning progress and change the learning experience so it is not too hard and not too easy. Pre-tests can allow students to skip parts of content that they already know.
 - ELearning develops students into better learners. It can allow students to select learning activities that best fit their own background, interest, and career at that moment, rather than forcing them to be a passive receptor of information chosen or prescribed by others. Research shows that eLearning leads to more active student participation than classroom training (Beam & Cameron, 1998)
 - eLearning never loses patience with learners.
- **Assessment and evaluation**
 - The process of student assessment can be highly automated. Assessments can be delivered, scored, recorded, and analyzed without human intervention.
 - Reports and data analytics can be generated in real time to show weaknesses in the performance of students and training materials.
- **Learning achievement**
 - "Rule of Thirds" (see above): (... increase achievement (holding time constant) by one-third...)
- **Time to learn**
 - "Rule of Thirds" (see above): (... reduce the time to achieve instructional objectives by one-third or increase achievement (holding time constant) by one-third...)
- **Collaborative learning environment**

- Physically separated students and experts can be linked together to form an online collaborative learning community.
- ELearning can be designed to allow students to ask questions that they may not be able to ask in conventional classrooms due to instructor pacing and style.
- ELearning allows students to safely express their personal opinions without fear of being judged, and to share ideas with each other more easily through online forums.
- **Unlimited use of learning materials**
 - ELearning allows unlimited access and retrieval of electronic learning materials. Information and knowledge are available to students 24 hours a day from any location. Students can review current or past information/knowledge stored in courses they have taken or content repositories over and over again.
- **Enabling implementation of training policy**
 - In the U.S. military, eLearning courses provide the glue or linkage that supports some of the new emerging training requirements, like Human Dimension, Army “Living Doctrine”, ePublishing, and Mobile Learning.

2.4 Types of general learning goals managed by LMSs

In an instructional sense, LMSs are generally designed to account for five basic categories of learning:

- **Initial learning** – acquiring skills and knowledge for the first time
- **Continued learning** – extending skills and knowledge in a particular domain
- **Remedial learning** – refreshing skills and knowledge for learners whose knowledge has decayed
- **Upgrade learning** – moving to a higher level of competence in skills and knowledge already acquired
- **Transfer learning** – transfer of skills and knowledge learned in one particular domain or context and transferring them to a different one. For example, a trained and experienced Flash® developer who is now working in Captivate® (which uses the same Flash framework but with a different interface)

Most LMSs support all of these goals, although the system functions that support them are not always the same. For example, the LMS needs to ensure that remedial learning learners are not tracked the same way as initial learning learners. Remedial learning learners should have access to all parts of a course (suspending all forced sequencing), without forcing them to take assessments and be graded as in initial learning.

In a logistical sense, the categories of learning delivery that LMSs can account for are:

- **Learner-led** – asynchronous, on-demand eLearning.
- **Instructor-led** – live presentation of content and supervision of learning experiences by an instructor.
 - **Co-located** – instructor and learners co-located, usually in a classroom setting.
 - **Virtual** – instructor delivery of learning to learners at a distance, using a technology such as video conferencing hardware or web conferencing software. Learners may be co-located in a distance learning classroom (without the teacher, who is remotely located). A

recording of such a session for asynchronous playback to learners then moves into the Learner-led category described above.

- **Facilitated** – so-called blended or hybrid learning. It combines elements of learner-led and instructor-led (see above). Facilitated learning is often used in situations where 100% instructor-led training is impractical or costly, and some parts of the content (but not all) can be delivered effectively through asynchronous eLearning.
- **Embedded** – job and task performance support through just-in-time Help and performance support systems.

It is important to note that LMSs do not often include support for all of these categories; in fact, these are the main differentiators for the categories of systems to manage and deliver learning (see 3 *Categories of systems to deliver and manage learning*).

2.5 Who uses LMSs and why?

Some aspects of LMSs can be handled by simply putting files on an intranet file server and using a spreadsheet or simple database for tracking purposes. However, most enterprises' needs go way beyond the capabilities of such a home-grown system. And developing a more robust system in-house can easily turn into a major software system development project, beyond the capabilities and budgets of many organizations. Thus, it is generally most cost-effective to acquire a commercial system, or customize an open source system.

LMSs base much of their value proposition on their optimization for ease of use by administrators and learners, and their automation of time-consuming tasks. They offer streamlined and efficient administrative workflows, which can be very time-consuming without carefully designed tools.

LMSs can be free and open source, but commercial versions can be cost-prohibitive for small organizations. They also are technically complex and require an administrative and maintenance infrastructure and resources that also can be prohibitive for small organizations. Thus, commercial systems generally make the most sense for an enterprise with hundreds if not thousands of users, where some level of centralized, automated control and record keeping needs to be exerted over the process of learning. This being said, “pay per use” pricing models for vendor-hosted LMSs can make an LMS cost-effective and practical, even for very small organizations.

Generally, an LMS is not needed where:

- There are only a small number of users (in this case, a system may be useful, but it would not be cost-effective).
- Learning can be delivered simply by sending learners a URL to a file located on a file server on the enterprise intranet and they are free to take the module(s) without any performance tracking requirements (or they can self-report their status).
- Learning is delivered through classrooms and/or hard copy medium such as paper documents, CD, or DVD, and little or no systematic, centralized tracking is required.

One important rationale for needing an LMS is the fact that small and mid-size companies or institutions do not have enough staff resources to maintain a full-service HR capability in which employee training needs are treated robustly and systematically. An LMS can fill some of this need by automating and streamlining processes.

LMSs are commonly used by a variety of groups, mainly including content developers, training administrators, course managers, system administrators, instructors, and learners. These roles are often accounted for in the default account categories/permission levels available in many LMS products. Each

group uses different functional areas or a particular functional area for different purposes, since each plays a different role in the learning delivery and management process. Figure 1 provides an example of how each group uses various LMS functional areas:

Functional area	Content Developers	Training Admins	Course Managers	System Admins	Instructors	Learners
Learning tracks and curricula	NA	Define learning tracks, curricula, and target groups associated with them	Ensure that course is correctly positioning within learning track or curriculum	Maintain system integrity of learning tracks, curricula, and target groups	Assign learners to learning tracks and curricula per training needs	Choose curriculum or view assigned curriculum
Course delivery preparation	Test developed courses to ensure proper functioning	Review courses in curriculum for content errors	Review individual course for content errors and delivery problems	Import and configure courses	Review courses to prepare for providing instructional support	NA
Course delivery	NA	Monitor to ensure curriculum is delivered as intended in training plan	Monitor to ensure course is delivered correctly	Monitor and allocate course delivery per bandwidth and server constraints	NA	Find, register for, and take courses
Operation of course	NA	Review curriculum to ensure operation as intended	Review course to ensure operation as intended	Configure LMS to enable proper operation of courses	Provide course instructional support (via LMS features that enable contact with instructors)	Use course features as intended
Course progress and completion	NA	Report progress across courses Bill for course usage, if applicable	Report and analyze progress on course Bill for individual course usage, if applicable	Maintain tracking database and generate reports	Monitor learner progress and completion and assign learners to additional courses as necessary	Gauge progress
Assessment	Program assessments (in LMS, if applicable)	Review assessments throughout curriculum to ensure compliance with training plan	Review assessments in course	Configure LMS to enable proper operation of assessments	Review assessment Review assessment results and take appropriate remedial action	Take assessment
Learner performance	NA	Assess, document, and analyze performance	Analyze course usage and learner performance to evaluate course effectiveness	Generate statistics and reports per needs of training administrator and course manager	Monitor learner performance and assign learners to additional courses as necessary	Monitor performance

Functional area	Content Developers	Training Admins	Course Managers	System Admins	Instructors	Learners
Competencies	NA	Define competencies	Ensure competencies are integrated into course	Import and export competencies to/from external systems	Take further actions based on learner competencies reported by LMS	Receive competency certifications from LMS

Figure 1: LMS functional areas and roles for each

2.6 The importance of choosing the right LMS

Choosing a system to manage and deliver your learning is one of the most crucial decisions any training organization can make. Though most of these systems contain the same basic collection of functional elements described in the previous section, they are optimized for different types of learning goals, learners, and organizations. Differences can be major in these respects. If your organization chooses a system that is not optimized for your needs, you could end up wasting your organization’s money and wasting time for your learners and administrators, or worse, predisposing learners against learning opportunities that may be important but are difficult to access and take.

Another critical factor in choosing these systems is durability. This relates to whether the system will have longevity in the marketplace such that it continues to be available and supported with periodic maintenance and upgrades. This is important, at least to account for evolutionary changes in the IT environment (both hardware and software) within which it operates. It also relates to whether the system will, in the future, support delivery of new file formats, possibly incorporating revisions to standards like SCORM.

As with all enterprise systems, LMSs should also be chosen with consideration for extensibility, scalability, and, generally, how they will fit and integrate within the overall enterprise architecture of the organization. Extensibility considerations tend to take into account the modularity of the system and how services can be customized or increased to meet changing user needs. When thinking about scalability, the growth patterns and projections of the organization are important in evaluating whether or not an LMS can meet the potential volume demands through growth. Fit tends to consider the organization’s other non-learning specific business needs and how the LMS will integrate and support other business-related systems. To this end, it is very important to involve appropriate non-learning stakeholders as well as IT department staff in all discussions from the very beginning.

Although this paper is primarily predicated on first-time acquirers of an LMS, most of this information is also applicable to those switching LMSs. There can be many drivers for this decision, but it usually comes down to cost and technology affordances. LMSs are gradually coming down in cost, and new LMSs are being built from the ground up to seamlessly incorporate new technologies. These two factors have been motivating training stakeholders to consider switching; according to a survey conducted by Bersin & Associates, one-quarter of customers were dissatisfied with their current LMS and said they were likely to switch vendors within the next year (Upside Learning, 2014).

3. Categories of systems to deliver and manage learning

Systems to deliver and manage learning run a wide gamut. This section describes the major categories of available systems. These categories are key to choosing a system, since they set the stage for allowing you to align your major requirements to the type of system you need. It is important to note that these categories are not mutually exclusive. Some systems have core elements that qualify them for two or

more categories. However, in these lists, systems are assigned to one category as their primary intended use or design architecture.

As described earlier, the labels for categories are used loosely by vendors and others. Many vendors simply categorize their system based on where they perceive the bigger market lies for their collection of capabilities, not based on their system's primary functionality. The other factor that plays into the categorization and labeling of systems is user community usage patterns. Many users in the higher education community will call whatever system they use a course management system (CrMS), whether it strictly fits that definition or not.

Some argue that the primary differentiating categorization scheme of these systems should be whether they are geared for corporate (including government) or academic users. The differences are usually apparent in the terms used within the product, for example "curriculum" for academically-oriented products vs "training track" for corporate-oriented products. The default when "LMS" is mentioned in public forums usually presumes a corporate LMS. These are indeed the predominant type of widely used LMS in use (67%). However, academic LMSs make up a large and evolving segment of the LMS marketplace (30%) (Vipond and Clarey, 2016).

However, the authors feel that it is more meaningful to categorize systems more in terms of pure functionality rather than the market within which they operate. Within each functional category of system (LMSs, LCMSs, CrMSs, VLEs) there are differences in the way the systems are designed and marketed, for the academic vs corporate market (and within academic, there are differences between K-12 and higher ed systems). However, we feel that focusing on functionality is more meaningful for those in the process of choosing an LMS, especially since "academic LMSs" are often used in corporate settings (especially in the case of corporate universities) and vice versa.

Although six categories of systems to deliver and manage learning are discussed in this section, this paper focuses mainly on systems that we categorize as "General-purpose LMSs".

3.1 General-purpose LMSs

LMS are optimized for delivery of learner-led and embedded learning, explained in 2.4 *Types of general learning goals managed by LMSs*. They can include support for facilitated and instructor-led training and education, but that is usually not their primary focus. They are primarily designed to manage and deliver asynchronous eLearning, although many of the large LMSs for corporate or academic use offer tools for administering traditional classroom-based, instructor-led training events (this is the primary function of CrMSs described in 3.4 *Course management systems (CrMSs)*).

This category is termed "general purpose" because it covers the systems with feature sets that are most universally applicable to a wide variety of use cases and users, accounting for most of the requirements that are common to all enterprise learning environments.

LMSs are used primarily in the business and government training community (although a growing number are oriented towards the academic community). This is ingrained into the minds of users to the point where many systems that technically fit into one of the other categories are often termed an LMS. Thus, the LMS label is used loosely, but for purposes of differentiating and categorizing systems in this paper, "LMS" includes only the systems that are primarily designed to manage and deliver asynchronous eLearning, as described above.

See *Appendix F Examples of products* for a list of example systems in this category.

3.2 Specialized LMSs

The LMSs in this list are explicitly geared and marketed for a particular use case, learning paradigm, or type of user. Many of them are delivery platforms only, and do not handle other functions of an LMS like

managing learning records. They differ from LMSs in the “General-purpose LMS” category in that the features in that category are generally applicable to most organizations, cases, etc., whereas “Specialized LMSs” are more “boutique” in nature. NOTE: for information about LMSs that specialize in mobile learning, see 3.6 *Mobile learning LMSs*.

See *Appendix F Examples of products* for a list of example systems in this category.

3.3 Learning content management systems (LCMSs)

LCMSs are closely related to LMSs, providing much of the same functionality with the addition of content authoring and robust content repository features. Although LMSs necessarily include a content repository as part of their architecture, LCMSs provide more flexible access to the content repository component and more management options for it.

The focus of an LCMS is the instructional content—its creation, reuse, management, and delivery. This contrasts with the logistics of managing learners, managing learning activities, and competency mapping provided by an LMS (Oakes, 2002). In other words, an LCMS focuses on the management of learning objects (LOs) while an LMS manages the learning process as a whole (Watson & Watson, 2007). This focus belies tremendous overlap in actual practice; Hall (2007) states that 74% of LCMSs in their LCMS research report include robust LMS functionality. And both systems manage and deliver instructional content (often at the LO level), with an LMS being the more comprehensive of the two in terms of system functions.

As in the case of LMSs, LCMSs are optimized for delivery of learner-led and embedded (especially performance support) learning strategies, explained in 2.4 *Types of general learning goals managed by LMSs*. Like LMSs, they can include support for facilitated and instructor-led training and education, but that is usually not their primary focus. LCMSs, like LMS, are used primarily in the business and government training community.

In its simplest form, as stated above, an LCMS is an LMS integrated with authoring tool and advanced content repository functions. LCMS content repositories are usually designed to manage many different types of content objects, not just eLearning (or even training-related), and generally include the following features that are not usually found in an LMS:

- Versioning of files and/or content objects
- Authoring of eLearning (through web-based tools on the LCMS server, not through software on the user’s system)
- Dynamic assembly of LOs into learning experience sequences (at runtime, usually)
- Ability to manage different and complex content object types. This includes providing navigation controls, look and feel, and a table of contents for a wide range of content object types.
- Web interface directly to the content files in the LCMS’s repository
- User roles and privileges to manipulate content
- Cataloguing (through metadata tagging) and search to enable discovery of content objects and/or files

Note that the term LCMS is sometimes simply used to refer to an LMS that has bolted on authoring capability, without meeting the spirit of the functionality described here for a true LCMS (i.e., dynamic assembly of LOs at runtime).

Be careful if you already have established an eLearning development capability, and staff in your organization are already using preferred standalone authoring tools. There may be significant resistance

(and licensing issues) to changing authoring tools to an LCMS midstream. In many cases, however, they can continue to use their preferred tools, and files produced by these tools can be imported into the LCMS.

As of 2013, LCMSs seem to be on the decline; according to a 2013 survey (Roche & Upton (2013), 63% of the corporate sector still used an LCMS, but Vipond and Clarey (2016) report that LCMS ownership is now down to 29%. There is speculation that the decline is due to the fact that content generation is becoming ubiquitous and crowd-sourced (user generated). For example, the ease of creating and sharing instructional videos on smartphones may outweigh any advantages of being able to author and manipulate video-based LOs in your LCMS.

The primary advantage of LCMSs over LMSs is that LCMSs enable assembly of courses (usually dynamically) from a variety of smaller source content objects. Thus, if your environment requires output of a variety of materials from a variety of source objects (for example, producing an eLearning course from instructor-led training manuals and vice versa), this is probably a good choice of a system.

LCMSs have the following advantages over LMSs:

- Learning modules can be automatically assembled for delivery by the system to the individual learner according to the learner's organization, role, language preference, learning needs, regional differences, etc. Many LMSs can do this, but LCMSs allow this process to occur on a much more granular and dynamic scale, i.e., learning modules that are delivered to the learner are the result of on-the-fly mixing and matching of smaller pre-defined learning objects within the system. In LMSs, this automatic selection and delivery process usually only happens on the level of whole courses.
- Learners do not have to spend as much time looking for relevant materials, since they are delivered automatically based on the learner's profile. LMSs often do this, but again, the tailoring of appropriate material happens on a much more granular scale in LCMSs.
- LCMSs can assemble different types of learning products (for example, references, ILT courses, and eLearning courses) from master objects dynamically. This means that edits can be made in a master object, and changes immediately ripple through all output products. This "single source, multiple outputs" paradigm can enable much greater efficiencies in content maintenance, especially where learning information is volatile.
- Content publishing to the delivery side of the equation, the LMS component, is easier, since the authoring tool and LMS component are integrated into one system.
- All of the advantages of web-based (as opposed to desktop software based) authoring tools accrue since the built-in LCMS authoring tool capability is always web-based. Possibly the biggest advantage here is that access to content for editing purposes by users other than a single course author (e.g., SMEs, clients, project managers, and multiple course authors) is easier. This can result in a significant boost in speed of authoring and updating content.
- The fact that learning modules are combinations of smaller learning objects tends to make it harder for instructors to create unauthorized personal "flavors" of courses, since there is less chance that they would have authoring permissions access to all of the components that make up a learning module.
- LCMSs include an integrated authoring tool, which usually allows you to import and edit existing content with export to multiple formats conformant to multiple standards or standards versions.
- Individual assets and learning objects (including screens) can be managed, not just courses. This can extend to objects used by the system in navigation screens, permitting scenarios where an

organization logo that is used for branding purposes on multiple LCMS system screens can be reused within content screens (and updated in one place).

- Individual assets can be version controlled and configuration managed via content repository functions.
- LCMSs are better optimized for delivering performance support modules, because of their object-based architecture, i.e., learning objects can be reassembled dynamically in a format that is better suited to the needs of users looking for just-in-time information. Performance support objects can be automatically selected for delivery by the system according to user media preference, user device (i.e., mobile vs desktop computer) or particular problem that needs to be solved.
- Competencies and objectives can be mapped explicitly to any level of course organization and to learner progress, in some cases assembling individual courses (not just curricula) for learners dynamically based on their training needs.
- Learning objects and assets can be easily reused (within the system).

LCMSs have the following disadvantages compared to LMSs:

- The learner management functions tend to be less robust, since the system concentrates more on the authoring, assembly, and delivery of content.
- Their capabilities are usually predicated on doing everything within the LCMS system. They may not interoperate well with other systems (for example, an external authoring tool).
- Navigation controls for courses usually are provided by the LCMS, not the content (this is especially true where the content is assembled dynamically).
- The level of effort (LOE) for administration is higher given the greater number of individual learning objects that need to be configured, version controlled, etc.
- The concept of an LCMS may be very attractive, but implementation requires more of a commitment (than an LMS) to reengineering your organizational culture to leverage its reusable learning object and “single source, multiple outputs” paradigm. If you do not make use of this LCMS capability, you could end up wasting money (over the cost of a comparable LMS).

See *Appendix F Examples of products* for a list of example systems in this category.

3.4 Course management systems (CrMSs)

CrMSs are most commonly used in higher education rather than enterprise training environments. They are sometimes called Education Learning Management Systems (ELMSs). The primary focus of CrMSs is to manage all aspects of live instructor-led classroom training, according to the categories of learning delivery explained in 2.4 *Types of general learning goals managed by LMSs*. They may include the ability to deliver learner-led courses, but these are usually supplementary or ancillary to the instructor-led courses they manage. As described earlier, many LMSs incorporate some level of CrMS functionality and vice versa, since many enterprises want to manage their instructor-led learning and eLearning in one system.

Do not confuse *course management system* (CrMS) with *content management system* (CMS) or *competency management system* (also CMS). The acronyms are differentiated here so as not to confuse, but often the same acronym (CMS) is used for all three. *Content management systems*, by contrast with *course management systems* (CrMS) are designed to manage work flow needed to collaboratively create, edit, review, index, search, publish and archive many kinds of content, mostly related to document publication. *Competency management systems* usually include an LMS and are more comprehensive in their approach to human resource development. They include tools such as skills-gap analysis and

succession planning. They are closely aligned with, and often the same as talent management systems (TMSs). See 7.11 *Adding talent management architecture and capabilities* for more details.

As stated earlier, CrMSs are used primarily in the academic community. That is their primary market target. CrMSs are sometimes labeled as LMSs within the user community, but they are distinctly different in the sense that they do not deliver the core learning experiences—those are provided live in classrooms. However, a CrMS vendor that has added eLearning delivery capability may term themselves an LMS (though the preponderance of their functionality really qualifies them as a CrMS).

CrMSs are predicated on the idea that instructors need to use the system to build content, manage their courses, and contact learners. LMSs are not usually designed from the ground up for instructor use as a core function. They are generally more optimized for standalone eLearning, with little or no instructor intervention.

The core features of a CrMS are:

- Instructors can store and post information and materials on the web relating to their classes, and can put these materials under version control and configuration management (including stages of production).
- Instructors and administrators can manage and schedule a variety of class-related resources, including classrooms and instructors, and ancillary instructional materials such as references and required readings. Conflict handling is often a part of these systems.
- Instructors can organize a class into groups and provide a group work space for working on group-specific tasks and projects.
- Instructors can mark and evaluate learner work while online.
- Instructors have grade book functions for recording learner performance.
- A portfolio space can be created for learners where they can showcase their work in a course, display contact information and a photo.
- Instructors can organize appropriate support materials including exercises, reference materials, labs, tests, etc. by course, class section, curriculum, etc.
- Learners can collaborate (at least among learners in the same class) using threaded discussion, chat and other communication or social media tools.

Some CrMSs also include functions related to tracking the analysis, design, development, and evaluation of training, and an audit trail for tasks, learning objectives, instructional activities, lessons, courses, and media.

In some cases, the decision whether to acquire an LMS vs LCMS may be difficult, as there is significant overlap. However, CrMSs are different from both of these in the sense that they generally do not provide the capability to deliver the core learning; they are mainly designed to manage the supporting infrastructure for live instructor-led classroom training. Thus, it is irrelevant to discuss advantages and disadvantages of CrMSs over LMSs, since the former are designed more for education than for training.

Keep in mind that because of the overlap in functions and features, differing product marketing strategies, and lack of universally accepted labels, CrMSs are often termed “LMSs”.

Specialized CrMSs are emerging for Massive Open Online Courses (MOOCs). MOOC CrMSs dispense with many of the standard CrMSs features related to managing classroom courses, since MOOC courses are by definition entirely virtual. In some cases, such as Coursera, MOOC courses are offered and delivered exclusively through a particular MOOC system; in others, the system can be used merely as the delivery platform, independently from courses.

See *Appendix F Examples of products* for a list of example systems in this category.

3.5 Virtual learning environments (VLEs)

There are many software tools designed for general web-based virtual business meetings and collaboration. VLEs (sometimes called virtual classrooms) are a subset of these. They are often marketed as webinar software, although webinar software tends to deal only with one specific learning event (usually a business presentation) at a time, not managing whole courses that might involve a collection of webinars (in addition to other elements).

The primary focus of VLEs is to deliver, and to some degree, manage virtual instructor-led learning (either synchronous or asynchronous). VLEs support management of learning to varying degrees, and to this extent they resemble CrMSs, but they focus mainly on providing the delivery capability. They can also, in classic LMS style, include support for asynchronous learner-led eLearning, but that is not their primary focus. VLEs are generally more targeted towards the formal educational environment rather than corporate training. VLEs are also used widely for MOOCs, although VLE sessions are generally contained within specialized MOOC CrMSs (see *8.3 Massive Open Online Course (MOOC) support*).

Note: Virtual immersive environments (VIEs) such as simulations, virtual worlds, serious games, and augmented reality are sometimes termed virtual learning environments (VLEs).

As in the case of CrMSs, it is moot to discuss advantages and disadvantages of VLEs as compared to LMSs, since they are designed for a different kind of learning experience. However, because they overlap much more nowadays with LMSs in terms of sharing the ability to deliver eLearning, it is worth pointing out some of the differences in the way these two systems function.

VLEs have the following fundamental differences from an LMS:

- They support the collaboration needs of virtual courses, thus emphasizing constructivist learning approaches much more.
- They are learning event-driven instead of course-driven.
- Assessments are usually tracked as separate activities, not as part of a specific unit of the course.
- Learner performance is tracked using instructor grade book data, for instance, narrative summaries of learner accomplishments and needs, test scores, and assignments completed.

Many VLE products are meant to be sold with other companion LMS products in order to attain full LMS capability. This applies especially to tracking functions, which VLEs alone often do not handle. Apart from mere attendance in VLE learning events, the tracking function includes standalone assessments and asynchronous content (with embedded assessments). However, some VLEs also dynamically track “engagement” on an individual and group basis via parameters such as:

- Whether the user has participated in chats
- How many questions posed by the instructor the user has answered
- Interactions with other users within breakout meeting rooms
- Status updates

Some VLE products are also designed to work with eLearning authoring tools, in order to provide content objects that can be used asynchronously before or after the live session, or content that is designed to be displayed by the instructor during the live session. For example, Adobe Connect® is designed to be used with content developed using Adobe Presenter®, which creates elearning from PowerPoint presentations.

Most VLEs incorporate videoconferencing capabilities, used typically to allow the instructor to broadcast a “talking head” of him/ herself to learners while slides or other media is displayed, in standard webinar fashion. This capability often includes the ability to display (one at a time or simultaneously) other talking heads (of other instructors and/or learners). See 7.16 *Video conferencing integration* for more information.

Some VLEs (for example, iCohere Unified Learning®) include features that allow them to be multipurposed for holding not just training sessions but virtual conferences, webinars, and collaborative meetings.

If you are considering acquiring a VLE, do not underestimate the retraining it may take for your classroom instructors to become effective VLE instructors. VLEs have different instructional constraints and opportunities, and potentially many more technical distractions than a live classroom. For instance, instructors should poll students (using features built into the VLE) frequently to gauge understanding and thereby adjust pacing. Instructors should also ensure that students know how to use the audio functions to mute themselves when not speaking to minimize distracting background noise.

VLEs are currently experiencing an upsurge in popularity. Roche and Upton (2013) report that 53% of the respondents in their 2013 *Elearning!* survey are now engaged in virtual events or virtual classrooms. Shank (2013) reports that 64% of the respondents in their survey use “Virtual classroom/conferencing tools”.

In addition to the basic ability to screen share media (especially slides) on the instructor’s computer and stream audio and video of the instructor(s), VLEs (especially ones that support MOOCs) usually offer the following features (Poiry and Wilson, 2013):

- Whiteboard
- Chat and Q&A
- Polling
- Hand-raising and instructor feedback
- Passing presentation rights and application sharing
- Breakout rooms
- Social networking backchannels
- Content annotation
- File sharing

See *Appendix F Examples of products* for a list of example systems in this category.

3.6 Mobile learning LMSs

Some vendors provide mobile-optimized versions of their LMS environments, or systems built from the ground up for mobile. These systems have interfaces that are optimized for mobile devices and facilitate delivery of eLearning and documents in mobile formats. They are usually quite robust in terms of social media functions related to eLearning such as creating discussion threads and posts, creating content items, commenting on blogs and journals, etc.

Some statistics are telling as to the need for management and delivery of mobile learning:

- Smith (2015) reports that 40% of the world’s population has smartphones, and 30% of smartphone users have taken a class or accessed instructional content on a phone.

- Shank (2013) reports in a survey of learning technology use that:
 - 31% use mobile phones/smartphones
 - 30% use tablets
 - 17% use mobile web pages

As for popularity of mobile learning, other statistics support continued growth in this learning technology approach:

- Brandon-Hall (2016) reports that mobile tools are cited as the #2 focus of technology exploration (41% of respondents) in their survey, just behind social/collaborative tools (43%).
- Vipond and Clarey (2016) report in their 2015 survey of corporate LMS owners that nearly one-half (46%) said smartphone support was an “extremely important” LMS feature, and more than one-half (55%) identified tablet support as “extremely important” for mLearning.

There is general agreement among eLearning professionals that the mobile platform is not suitable for delivering standard eLearning, i.e., complete eLearning courses created for desktop delivery that have been reformatted for mobile delivery. This has mostly to do with the duration of courses; mobile users generally do not have the patience, proper context, and an uninterrupted time frame (while not at their desk) to consume training information on small screens for long periods. Thus, mobile delivery is often cited as being most suitable for small chunks of learning, sometimes called “microlearning” (see 7.30 *Microlearning*) and short duration learning-related functions such as:

- Tests
- Surveys
- Short videos
- Just-in-time performance support, ranging from highly interactive coaches and decision support modules to static job aids
- Social media tools that provide access to experts, mentors, and communities of practice
- Drill exercises (e.g., electronic flash cards)
- Learning-optimized references (e.g. infobases)
- Collaboration platforms for informal learning
- Sharing of files (e.g., photos taken on the mobile device), usually via integration with a 3rd party service such as DropBox.
- Grading (for instructors)

One figure that sets a realistic maximum duration for any learning experience on a mobile phone is 26 minutes. That is the average length of a commute in the U.S. (Barry, 2016). Commuting is obviously a convenient time used by many learners to consume (usually audio-based) mobile learning.

Smartphones are particularly well-suited to location-based, contextual learning because of their built-in GPS capability. Games for learning can work on the mobile platform, but generally only if they are simplified. If you are acquiring an LMS for mobile learning, you will need to consider carefully what kinds of learning experiences will be delivered, based on what is really appropriate for the mobile platform (given the above examples).

Supporting mobile learning can be a complicated proposition given the overwhelming trend of “BYOD” (bring your own device) in the workplace. Employees want to take learning on their own mobile device(s), and many companies do not have the resources or inclination to supply standard devices anyway. Accounting for the differences in mobile platforms requires the LMS to detect the device and adapt its delivery configuration accordingly (called “responsive design”). This is not completely new to LMSs, in that differences between mobile and desktop browsers in the early 2000 required this adaptive content approach. In spite of the many technical issues for LMSs in this regard, LMSs are quickly rising

to the occasion. Responsive design as part of the standard feature set for authoring tools has become a major help in filling the gap.

A significant issue with the BYOD paradigm is that users do not want to use their data plan to download work-related content. This content can eat up their data plan quickly if it includes media files like high definition video. To avoid this, content provisioning and tracking data synchronization features are incorporated in mobile LMSs, in which users can download content and send assessment data while they are on a wireless network, and consume the content later while offline (with tracking data cached until back online).

Despite the cost, enterprise-supplied mobile devices, especially tablets, are gaining popularity, particularly under term lease agreements with suppliers (i.e., during the designated training period). However, enterprise-supplied devices are generally not worth the cost and maintenance burden (and the burden on the user of carrying around another device) unless the enterprise takes full advantage of the control over these devices that ownership of them affords. Systems that implement this control are called mobile device management (MDM) systems. MDM can apply to both BYOD and non-BYOD environments, but they are obviously quite limited in the case of the former, in terms of the amount of control users are willing to allow over their personal devices (for example, auditing and wiping phone data if a security risk is detected).

MDM systems can take care of most of the security issues that would normally need to be handled by a mobile LMS, covering four categories:

- Content security
- Device security
- Application security
- Transaction security

Either through the mobile LMS or an overarching MDM system, these issues need to be addressed in a mobile learning environment. Application security is probably the most vulnerable of these, and the one that MDM systems typically focus on. Application security issues for learning applications includes:

- Authenticity of the app
- Secure access to content and other enterprise systems
- Storage of content on the local device either for offline use, or cached through normal application processes
- Forcing users to upgrade apps to fix newly identified vulnerabilities

In choosing a mobile LMS, it is important to distinguish two kinds of mobile LMSs: “mobile friendly” and “mobile responsive” (the categories are mutually exclusive). Mobile friendly simply means that features that would preclude using a mobile device to access the LMS are stripped out (e.g., navigation drop-down menus, rollovers). No Flash animation is used, and usability is more or less maintained, regardless of the device on which the system is being viewed.

Mobile responsive describes an LMS that changes the screen size, layout, and other interface features due to the constraints of the device, based on detection. For instance, text and images may change from a three-column layout to a single-column display. Fonts are enlarged, and some images may be hidden. The interface may change dramatically between a desktop view vs a smartphone view. Mobile responsive is recommended to ensure a more optimal user experience for mobile users; in fact, offering a mobile app option for the LMS rather than a web site based on mobile LMS users is becoming more and more common, since it allows the greatest control over responsive features.

Udell & Woodill (2015) describe a spectrum of categories for LMSs to implement mobile learning optimization, as follows:

- **Level 0**—LMSs not ready for mobile learning
- **Level 1**—LMSs graphically redesigned for mobile devices
- **Level 2**—mobile extensions (“plugins”) for existing learning management systems; the extension only works in conjunction with a non-mobile LMS
- **Level 3**—standalone, self-sufficient mobile learning management systems
- **Level 4**—innovative mobile learning management systems that use some of the new affordances of mobile devices, such as location detection or cloud computing.

An interesting possibility that supports the idea of “spaced learning” (see Thalheimer, 2007) is the ability to send SMS text messages to learners containing actual learning content as reinforcement for prior learning. An LMS that has a built-in SMS engine can also be used to push learning tasks out to learners, asking them to try applying something they learned in previous content in their present work situation. These learning tasks can be quite effective in developing new work habits. Apps that pop up alert messages with content reminders can also be effective. Some apps like Mobile Coach® have AI “bots” (i.e., coaches) that learners can engage in short learning conversations with.

Eventually, learner context detection (location, speed, etc.) will advance to the point where appropriate learning objects can be automatically be pushed to learners at the time of need or availability. This capability may ultimately not be part of the LMS, but delivered by personal assistant for learning (PAL) software (possibly in combination with augmented reality hardware); ADL is currently pursuing development of PAL prototypes.

See *Appendix F Examples of products* for a list of example systems in this category.

For more information on mobile learning and the ways that LMSs can support it, see the Mobile Learning section of ADL’s Web site at <http://www.adlnet.gov/mobile-learning>.

4. Special features and issues to consider

4.1 Enterprise system integration

In 2011 (Brandon-Hall, 2012a), enterprise system integration was the most important requirement enterprises have for a new LMS that is to replace an existing one. In 2015, it was still third (of nine) from the top of the list, according to a newer report (Brandon-Hall, 2015). This report outlines the distinction between learning tools integration and business system integration, where “Learning related tools include support tools that are often separate but need to work in conjunction with a Learning Management System, such as assessment builders, virtual classrooms, or an enterprise social network.”

Business system integration, it goes on to say, “... goes beyond the traditional employee payroll system, and now includes requirements to integrate with enterprise resource planning systems, e-mail tools, sales platforms, marketing platforms, single sign on systems and HRIS platforms.” (Brandon-Hall, 2015, p. 8).

There is also a strong trend of integration with social platforms, especially YouTube, Facebook, and Twitter. Often, an LMS vendor will try offering integration with an external service first, then developing and including the same or similar functionality within its own closed system architecture. See 7.

Emerging trends in LMSs for details on many functions that are trending towards being integrated into the LMS.

For LMSs used in a corporate setting, probably the most important system to integrate with is the human resources management system (HRMS); for LMSs used in an academic setting, the key system integration hurdle is to integrate with student information systems (SISs), to handle transcripts, manage credits, etc.; in associations (professional and trade organizations), integration with member management systems (MMSs) would be important.

The main driver for an LMS to integrate with other learning tools is essentially to avoid giving learners a reason to leave the LMS environment for some key part of the learning experience, which would dilute the “one stop shop” value model and convenience factor for the LMS. It also generally facilitates control and tracking of the learning experiences managed by the LMS.

The main driver for business system integration with the LMS is to avoid data redundancy and version control issues, and automate migration of data through the enterprise in a seamless process. A very common system integration requirement is to have the LMS pull employee profile data from an HR system, so that lists of mandated or eligible learners do not have to be maintained separately in both systems, and meeting of training qualifications and certifications via activities learners do in an LMS can easily trigger HR system events such as meeting compliance requirements and eligibility for promotions.

Some regulatory agencies are starting to offer system integration with LMSs so that learners can immediately receive certifications directly from those agencies, rather than “second hand” through the LMS owner.

There are many considerations in planning for system integration. See Brandon-Hall (2015) for a list.

4.2 LMS skins and templates

LMS skins are generally style sheets that globally control the appearance and format of the LMS interface (differentiated from skins used in the context of authoring tools, which refers to the ability to globally apply a look and feel to the content itself). They usually include banner graphics, logos, color schemes, etc.

Skins can enable local variations on parent LMS interfaces, providing each organization within the enterprise with its organizational branding. This can ease the barrier of sharing an LMS across an enterprise, potentially saving a lot of money. Skins can be determined in advance, or can be dynamically applied depending on the user’s demographic information (such as organization they belong to, or the country in which they reside) in their profile. Skins can include changing the language of the interface.

Do not confuse the concept of an LMS template with the concept of templates in authoring tools, where a starting point for building a screen or content object is predetermined, gaining production efficiencies. The concept of LMS templates (some other term may be used for this concept within the LMS product) refers to any saved set of parameters that can quickly be applied to any content or functional object. These parameters can govern such things as workflows, course configuration, learning tracks, and permissions. For example, templates can be sets of permissions or roles that can be repeatedly assigned to individuals who are members of certain groups or functioning in certain roles, or whole groups. Thus, a whole set of permissions can be applied all at once, to more than one user. Templates can also refer to screen templates for building assessments that can be created and used within an LMS.

4.3 Programming language and platform dependencies

Some LMSs are built using programming languages such as Java that require software runtime interpreters to be installed on client computers. This can be a problem for users who do not have the minimum required version of the interpreter, perhaps due to enterprise IT policy not approving it or restricting users from doing their own software updates. Even if they are allowed to install the runtime interpreter, it is not user-friendly to require them to do so in order to access the LMS, and it complicates

IT support for the LMS. Some LMSs in recent years whose codebase was Java are now switching to other codebases for these reasons.

Other LMSs are built on database platforms such as Oracle® or content management systems such as SharePoint®. These require purchase (and maintaining a current license) of the underlying platform, which can be costly, unless you already have an enterprise license for that platform.

It is important to determine what these programming language and platform dependency requirements are for an LMS you are considering purchasing, since it can have a substantial impact on cost and deployability. This also relates to customization of the product, since the programming language may be one that your programmers are not familiar with, making customization difficult.

Some vendors (e.g., ShareKnowledge®) offer business models whereby they customize enterprise platforms (e.g., Microsoft SharePoint, WordPress) to look, act, and feel like LMSs. This can be an attractive option, if you want to host your LMS behind your firewall. The advantages to this model for acquiring an LMS are:

- Lower cost if the enterprise already owns a license for the base platform.
- Leverages the existing IT infrastructure that supports the enterprise's base platform.
- Lower training costs since users presumably already are familiar with how to use the base platform.
- Much of the content is probably already in the system, therefore there is no need to transfer it from one system to another.
- Leverages existing security, content management, user profiles, and other business rules and workflows already in place for the base platform.
- The enterprise will be able to take advantage of new features added to the base platform that often have relevance to learning or LMS functioning (especially social media).

It is important in these cases to ensure that you are truly able to leverage your base platform technical support staff and administrators. If the product is so heavily customized that it requires additional administrators and support staff, the cost advantages could be seriously diluted.

4.4 Pricing models

As with many complex, large software systems, vendors will have their own particular pricing model that they feel positions them best in the marketplace and suits their needs; this makes it difficult to compare prices between vendors. However, there are certain basic categories of pricing models, as follows:

- **Perpetual license** –this model involves paying a one-time fee that allows you to “own” the software. This may be a cost saving model for you depending on what the fee is and how much you plan to use the system. This model assumes that you will either host the system behind your firewall or on a public cloud service (see 4.10 *Hosting options* for more information), since it is yours to do whatever you want with. This model is increasingly rare.
- **Subscription-based license** – this model is by far the most standard (for most large software systems of any kind, in fact). You are charged a (usually monthly) fee based on number of users, usage, storage, etc. (see list below). This usually presumes that the system is hosted behind the vendor's firewall (see 4.10 *Hosting options* for more information), and can thus be monitored by the vendor for usage patterns, which determine the price you are charged. Under this type of license, there are a number of usage patterns that can be used to determine price, as follows:

- **Seat-based** – this model uses the number of employees in the enterprise, or possibly the number of employees who will ever need training in the enterprise, as a basis for pricing. These “seats” are a maximum number of people who may end up logging in to the system over its life cycle. There are usually tiers of seats (for example, up to 10,000 vs up to 20,000 users). Do not confuse seats as a pricing model with system capacity seats. The latter is the number of concurrent users that can safely use the system without overburdening it.

Seat-based pricing can run into problems with “extranet” users. If partners, customers, and others outside of the enterprise (i.e., other than employees) need to use the system, accounting for their numbers accurately may be complicated, and may need to be based on unreliable estimates.

- **Usage-based** – this model is based on the number of learners who actually use the system. It is not based on the potential number of users who *could* use the system, as in seat-based pricing; it is based on either the number who *actually* do use it to take training (sometimes called “pay per active user” model) or indicate by registrations that they intend to use it (“pay per user” model). The time period needs to be accounted for in the price as well; 1000 users registering for a course and only using it for one day can be a different pricing scenario than those 1000 users using that course for 6 months.

You should ask the vendor to define what constitutes “use” of the system in the case of this model. It could be defined as merely registering for an entire curriculum, starting a single course within a curriculum, accessing resources such as videos, etc.

This model is particularly attractive in the case of anticipated LMS usage surges, due to such events as new product releases and seasonal cycles. In these cases, where there may be little usage of the system except in certain short periods, paying for a baseline of seats may be less economical than paying per use, for time used.

Usage-based models can make a hosted solution (see 4.10 *Hosting options*) especially attractive, since your organization does not need to permanently maintain a full complement of server, bandwidth, and support resources to handle the highest load times. That is the responsibility of the vendor, and you will only be charged for the (potentially) short time that usage peaks.

- **Storage-based** – this model is based on the size of the files that are stored in the content repository section of the LMS; 10 Gb of files will cost more than 5 Gb of files, no matter what the usage patterns of either.
- **Flat fee** – for this model, it doesn’t matter how many users you have or how much bandwidth or file space you need. The fee is the same in all cases. This is similar to the perpetual license already mentioned, except that here you pay a periodic subscription fee rather than a one-time fee, and it is vendor hosted. An example of this type of LMS is Topyx®.
- **Free** – This only applies to open source LMSs, where you download the free software and host it yourself (otherwise it is not free since you are paying for hosting). Of course, there are many ancillary costs to maintain and customize such a system, so it is not, technically speaking, “free”. For more information on open source LMSs, see 4.6 *Open-source or freeware solutions*

On top of these pricing models, some vendors offer additional tiers of features that can be unlocked for a fee. For instance, you can have streaming video or integration with a web conferencing tool added to your baseline product. There are also tiers of support that you can buy above the basic level. Tiers of features or support could save you money, since you are not paying for what you don't intend to use.

4.5 Return on investment (ROI)

If you are currently switching from ILT to eLearning as your standard delivery mode of training, your ROI calculation for acquiring an LMS to support this switch should take into account cost items such as:

- Number of people you train
- Number of course hours per year these people will need to be in training
- Number of courses
- Cost to develop eLearning courses (if you do not already own content)
- Cost of travel and accommodation for people to travel to ILT courses
- Per hour compensation rates of employees for time in training (for both ILT and eLearning)
- The annual cost of the LMS, given the most likely pricing model that you will adopt.
- Cost of maintaining and administering the LMS, or cost of hosting service (there can be lots of different elements included in this cost – you may need a brainstorming session among managers to create an accurate list).

Perhaps the most important factor in determining ROI is how much of a difference the training delivered by the LMS will make in the performance of individual employees (Kirpatrick Level 3) and the overall performance of the organization (Kirpatrick Level 4). These are notoriously difficult factors to assess and quantify, whether an LMS is being used or not.

One approach to this problem is simply to accept the “Rule of Thirds” (Fletcher and Foster, 2002), as follows: “Data drawn from many evaluations of technology-based education and training indicate overall that these systems can reduce costs by one-third and that they can additionally either reduce the time to achieve instructional objectives by one-third or increase achievement (holding time constant) by one-third.” (p. ES-1)

Another data point relates to the fact that, with an LMS, students do not need to travel to the training site and have housing provided for them. The cost savings from this are considerable. In 2014, the U.S. Army calculated that it saved \$84,000,000 by using eLearning, as opposed to training that required students to travel to the classroom facility (U.S. Army, 2015).

Cohn and Fletcher (2010) present a method of calculating ROI (for a training program, not an LMS specifically) that assesses the long-term impact of potential training capabilities, combined with a wider set of metrics that account for research and development investments, equipment purchases, equipment maintenance costs, learner and instructor time, follow-on sustainment, and on the job training. This ROI method can be used to compare specific training applications using eLearning vs classroom training methods. No actual comparisons were done in this study, but the evidence from other research (cited in this document) implies that eLearning should show a substantially better ROI than classroom training.

4.6 Open-source or freeware solutions

Open source options are attractive due to the absence of any licensing cost. However, it is important to be aware of the pros and cons of acquiring an open source solution, as the cost could, over the life of the

system, equal or exceed a commercial system. It's easy to be over-enamored of the free license aspect and ignore the required (possibly extensive) customization and support that may be necessary.

It is also easy to overlook the potential advantage of open source systems in that the product can be completely tailored to the particular requirements of the organization. If managed properly, this advantage can make an open source solution cheaper, not just because the license is free, but because the development and customization efforts can be focused solely on the needs of the organization and nothing more. Contrast this with a commercial product with lots of features that your organization may not need (but you are paying for them nonetheless). The business model for a standard commercial system is to build to the widest set of possible requirements to attract the widest client base. Your organization may not have all or even most of these requirements.

All of the above being said, acquiring an open source LMS usually does save money. For instance, the manager of a large U.S. government agency's eLearning initiative reported to the authors that switching to an open source enterprise LMS is costing them 60% of the ongoing costs of the commercial system they had been using.

Open source systems are indicated in the lists of systems in *3 Categories of systems to deliver and manage learning*. Descriptions of popular open source systems can be found at <http://barrysampson.com/2009/04/open-source-lms-10-alternatives-to-moodle/>

On October 16, 2009, U.S. DoD issued new guidance on open source software (see <http://dodcio.defense.gov/Portals/0/Documents/FOSS/2009OSS.pdf>). The guidance establishes open source software as having equal weight as proprietary software during acquisition evaluations. It is a break from the past, when open source software was deprecated for use in DoD due to security and quality concerns.

The benefits of open source software are described in this guidance document as follows (open source is referred to as OSS):

- The continuous and broad peer-review enabled by publicly available source code supports software reliability and security efforts through the identification and elimination of defects that might otherwise go unrecognized by a more limited core development team.
- The unrestricted ability to modify software source code enables the Department to respond more rapidly to changing situations, missions, and future threats.
- Reliance on a particular software developer or vendor due to proprietary restrictions may be reduced by the use of OSS, which can be operated and maintained by multiple vendors, thus reducing barriers to entry and exit.
- Since OSS typically does not have a per-seat licensing cost, it can provide a cost advantage in situations where many copies of the software may be required, and can mitigate risk of cost growth due to licensing in situations where the total number of users may not be known in advance.
- Open source licenses do not restrict who can use the software or the fields of endeavor in which the software can be used. Therefore, OSS provides a net-centric licensing model that enables rapid provisioning of both known and unanticipated users.
- By sharing the responsibility for maintenance of OSS with other users, the Department can benefit by reducing the total cost of ownership for software particularly compared with software for which the Department has sole responsibility for maintenance (e.g., GOTS).
- OSS is particularly suitable for rapid prototyping and experimentation, where the ability to "test drive" the software with minimal costs and administrative delays can be important.

(Department of Defense Office of the CIO , 2009)

Furthermore, on September 8, 2016, U.S. Office of Management and Budget (OMB) issued new guidance on open source software (see <https://sourcecode.cio.gov/>). This memorandum is aimed at ensuring that new custom-developed Federal source code be made broadly available for reuse across the Federal Government. As part of this policy, it includes stipulations that require agencies, when commissioning new custom software, to release at least 20 percent of new custom-developed code to the public as OSS for three years, and collect additional data concerning new custom software to inform metrics to gauge the performance of this policy. (Scott, T. and Rung, A., 2016). They cite the benefits as follows:

“While the benefits of enhanced Federal custom-developed code reuse are significant, additional benefits can accrue when source code is also made available to the public as OSS. Making source code available as OSS can enable continual improvement of Federal custom-developed code projects as a result of a broader user community implementing the code for its own purposes and publishing improvements. This collaborative atmosphere can make it easier to conduct software peer review and security testing, to reuse existing solutions, and to share technical knowledge. Furthermore, vendors participating in or competing for future maintenance or enhancement can do so with full knowledge of the underlying source code. A number of private sector companies have already shifted some of their software development projects to an OSS model, in which the source code of the software is made broadly available to the public for inspection, improvement, and reuse.” (Scott, T. and Rung, A., 2016, p. 2).

What is important to understand about open source software is the relationship it behooves you to build with the open source community that has arisen for the open source product you are acquiring. Staying in touch with the community in order to be able to discover and use already developed modules of functionality that you need (that are not part of the product baseline) can decrease your customization costs enormously. Open source communities often remind you that deploying open source means you are a responsible member of their community. There is an expectation that you contribute, as well as receive code, training, and documentation from the community. The cost of staying active in the community and both researching and acquiring as well as sharing your products and solutions must be factored into the level of effort for acquiring an open source tool. Open source LMSs are often backed by non-profit organizations, such as the LRN consortium, Claroline Consortium, and the Sakai Foundation.

It is also important to evaluate the strength and size of the open source community for the open source product you are acquiring, as well as the longevity of the product. This can mitigate obvious concerns that major sponsors of open source software can stop development at any time, or that communities can atrophy. Another possible concern is that a tool can grow so quickly in its popularity that documentation takes a back seat to development and has not caught up to the current release of the software; especially in the case of open source software, where you have no vendor who is obligated to support you, a lack of adequate documentation can make a product difficult to install, use, maintain, and troubleshoot.

Finally, the baseline versions of some open source products are usually very basic; some level of customization is often needed to make the software not only meet your special requirements but also meet a modest level of universally recognized functionality for the type of product. It may be risky to assume that an open source product will be usable straight out of the box. If you have no development resources ready and willing to augment the product’s functionality right after you acquire it, you may not be able to use it for some time. Some companies (such as Lambda Solutions) have built their business model on selling customization and support services for open source LMSs such as Moodle or Totara.

Due to the above concerns, despite their economic advantages and often robust functionality, open source systems have not yet taken up a substantial share of the LMS market.

Freeware may or may not also be open source. Freeware may have restrictions on copying, distributing, and making derivative works of it, where open source software does not. And freeware does not necessarily make source code available. Freeware may be restricted to personal use, non-profit use, non-commercial use, etc. Freeware that is not open source is a risky investment, since you cannot easily customize it.

There may be special restrictions on use of open source or freeware within your organization. For U.S. DoD, see <http://dodcio.defense.gov/OpenSourceSoftwareFAQ.aspx>

4.7 Government off-the-shelf (GOTS) solutions

This section only applies to government entities. GOTS software can be created either by the technical staff of a government agency or by a commercial vendor (usually the latter). GOTS systems usually have the following characteristics:

- The government has direct control over most aspects of the product, including the source code.
- The vendor or creator has given a license to the government entity who paid for it to freely use and share it within the government. The license does not permit the government to give or sell it to outside entities. In most cases, however, the software can be sold by the vendor to an outside entity.

Many of the same considerations described in 4.6 *Open-source or freeware solutions* apply to GOTS solutions as well.

A popular model for GOTS installations is to have regular meetings where representatives from organizations that use the system throughout government discuss new requirements and possible new features. At these meetings, agreements are made between the representatives as to sharing the cost for adding these features (which, after they are developed, are available to all users).

The original vendor/developer is usually the preferred entity for doing the customizations, since their developers were directly involved in creating it and have the most knowledge about working with the code base. This pre-existing experience and expertise can substantially reduce the cost of further development and customization. A GOTS license does not stipulate that the original vendor has to do the customization, however.

4.8 Offline content provisioning and player capability

This concept involves allowing LMS content to be played and LMS functions to be performed in environments where there is no, intermittent, or limited bandwidth or connectivity to the LMS. It often refers to mobile devices, where user network access is less stable and reliable (and can be expensive). Content that is to be consumed must be provisioned to the device at a time and place when there is stable and cheap connectivity, such as on a free wireless network (as opposed to cellular data network), then used offline. The local device must have a player capability (a web browser might suffice) in order to play the content.

Some LMSs are appearing that have extensive pick lists of specific LMS functions and content from which the user indicates what they would like downloaded in advance and stored locally vs on the server so that they can successfully work offline. They can thus micromanage the connectivity requirements and bandwidth load based on their specific situation.

Disconnected use scenarios can involve getting the content from a CD or from a download at a time and place where bandwidth and connectivity is available. He or she runs the course(s) on their local system with an offline player, which could be on their own computer or a shared community computer. Then, he or she uploads performance data to the LMS at a later time when there is sufficient bandwidth/connectivity.

Sometimes offline players are needed when there is a differences of content, and all of it cannot be delivered through the LMS due to file format incompatibilities between the content and the LMS. In this case, the LMS can be used to author and deliver assessments and store tracking data only. The delivery capability can be handled through an offline player (possibly provided by another vendor) that can display the

content. Learners can take courses using the offline player and then log in to the LMS to take the assessment and have their performance tracked.

There are special concerns for SCORM content delivered from a SCORM LMS, since SCORM normally requires “session data” to be written as the learner progresses through a course within a session. This is not such a problem for SCORM 1.2, where data can be packaged and sent after the user has consumed the content, but for SCORM 2004 with sequencing, the LMS needs to know in real time what the user is doing so that it can sequence next events properly. Workarounds can be created, but SCORM does not generally work very well with offline players. Due to a large demand for them, they do exist in the marketplace, however. Vipond and Clarey (2016) report that 70% of their LMS survey respondents said an offline SCORM player is “extremely important” or “very important”.

The following are examples of offline player scenarios:

- If learners have intermittent connectivity (for example, Navy personnel on ships who have connectivity at their base but not on their ship):
 1. While they have connectivity (ideally through a free wireless network), learners log in to the LMS.
 2. Learners check out (i.e., download, which registers their intent to consume) required/desired course(s). This locks the course(s) down so learners can only take them in offline mode (otherwise there could be data conflicts with taking the same course in both online and offline mode).
 3. Learners take the course(s) in offline mode through their offline player (often a mobile web browser) or pseudo LMS.
 4. When learners return to a location that has connectivity, they log in to the LMS
 5. The courses are automatically checked back in (or, in some cases, the user needs to manually check them in).
 6. The offline player (or pseudo LMS) updates all of the learner’s records in the LMS to reflect offline courses taken, test scores, etc.
- If learners have no connectivity (for example, learners don’t have their own computer and/or are in a remote area with no internet connection):
 1. Someone in the learner’s organization (for example, an administrator at an HQ site) connects to the LMS.
 2. The administrator checks out the learner database for a selected group of learners, along with the catalog of courses needed for those learners. This database contains all of the records of learner performance, etc. He or she downloads this as a .zip file and puts it on a USB drive.
 3. This drive is sent to the learner location.
 4. At the learner location, the USB drive is loaded on a community computer(s) that everyone shares, or individuals’ computers.
 5. Each learner takes their required or desired course(s) using the offline player. As courses are taken, data is written to the learner database about learner performance, courses completed, etc.
 6. After everyone has taken their courses, a .zip file is created from the learner database on the USB drive, using a utility. If individual learners have taken courses on their personal

computers, the files need to be collected onto one computer, and this utility consolidates them into a single .zip file.

7. This .zip file is sent back to the site that has connectivity.
8. The administrator at this site uploads the learner database to the LMS using a web service.

Some LMSs are starting to use a scenario where content is downloaded and stored on a local device (usually a tablet) as a default rather than delivered in real time at the point of use. Content is synchronized and updated at regular intervals whenever there is connectivity (via a high speed wireless network, for a mobile device). See 3.6 *Mobile learning* for more information.

These and other offline content scenarios can be handled by ADL's xAPI standard (with or without an LMS). See 4.15.8 *ADL Total Learning Architecture (TLA)*.

4.9 Security considerations for LMSs

Like any other enterprise system, LMSs must meet the security needs of the organization. This is especially true in the current era, where LMS functionality is largely delivered via the Internet, not enterprise intranets or extranets (the driver for this migration is mostly to allow greater access to learning).

For commercial installations, LMS security amounts to:

- Vulnerability to malicious penetration attacks and malware, resulting in loss, theft, or corruption of data. This security concern is no different from any other enterprise system, and the LMS would presumably be no more vulnerable than any other IT system.
- Protecting against unauthorized login. This is primarily not so much a function of the LMS, whose login functionality relies on universal web standards, but rather the placement of the system within the corporate intranet environment and the inherent security features of that parent architecture. Commercial entities are of course concerned about other organizations gaining competitive advantage by seeing the training of competing companies, and government has obvious security concerns, so access to the system is a primary concern.
- Privacy policies and access to Personally Identifiable Information (PII) may be an issue depending on how public access to your LMS is and what kind of information you store on it about your users. EU Internet privacy rules, Canada's Freedom of Information and Protection of Privacy Act, Family Educational Rights and Privacy Act (FERPA), and the US Patriot Act may be a consideration. Maintaining PII standards usually involves some level of encryption of the data stored in the LMS.
- Locking users out of capabilities that are not permitted in their user profile, in other words, keeping users from doing particular things, once in the system, that they are not authorized to do. All LMSs include levels of permission based on roles, but beyond this, they vary widely in terms of the types and number of roles and permissions that can be assigned. These permissions need to be segmented so that they map to the levels and specific kinds of permission that your organization requires. The question here is, if the system forces you to use a permission/roles assignment template, how applicable is it to your environment, and can templates be tailored to meet your needs? Is there an override that permits assignment of individual permissions on a function-by-function basis?

For DoD organizations, there are specific considerations relating to the possible harmful effects to national security and individuals' life and limb due to unauthorized access to the system and particular

courses that may be classified, etc. There are a number of issues that need to be considered in this regard. See the *Appendix E: Security Considerations for DoD LMSs* for a detailed list.

It is important to find out what programming language and third party OEM components were used to build the LMSs you are considering acquiring. There are innate security considerations for some programming languages.

A number of security concerns come into play for hosted solutions, since in that case both your content and the LMS system reside outside of your firewall. These concerns generally are the same for cloud computing, which has become indispensable and ubiquitous throughout all aspects of learning technology, playing a vital role in providing the services people and employees use in their everyday life. But as cloud computing has risen in use and mission-critical importance, concerns related to privacy, data security, and even sovereignty have emerged. One partial solution is to use a “private cloud” with VPN access for those outside of the enterprise network. This however, may not work in an environment where public access to your LMS is required. Custom-designed hybrid cloud solutions are becoming more and more common to meet specialized security needs that a standard cloud cannot.

4.10 Hosting options

There are three options for hosting most enterprise learning systems, including an LMS:

- Behind your firewall
- Vendor-hosted
- Public cloud-hosted

Most LMS vendors offer the first two options; a few are now offering the last. A vendor-hosted LMS is installed and managed on the vendor’s server by their staff, rather than behind your enterprise firewall by your staff (the “behind your firewall” option). Public cloud-hosted solutions refer to hosting the LMS not behind your own enterprise firewall but on a public cloud service such as Amazon Web Services (AWS). This could be arranged and managed by your staff, or the vendor’s. In some cases, vendors do not host on their servers but only do so on a public cloud service; in this case, “vendor-hosted” means effectively that also that it is public cloud-hosted.

If you (not the vendor) use a public cloud hosting arrangement for your LMS, you still have full configuration and management control over the LMS; the only difference is that the software is hosted on rented server infrastructure outside of your firewall. However, public cloud hosting often requires a different approach than either of the other two options because the server configuration options are limited; they are controlled by the cloud service vendor. Often the LMS vendor must make alterations to their LMS to conform to the cloud infrastructure requirements.

The advantages of your using a public cloud hosted LMS solution in this way are the same as with any public cloud hosted system; you do not have to acquire and maintain the server infrastructure yourself (which could be significant for a large LMS installation), and there is less load on your network. However, since it is not hosted by the vendor, your staff will still need to do updates and maintenance on the system.

The fact of being hosted on a server outside of your firewall can raise security concerns. These are gradually being eased. For instance, DoD now allows Amazon Web Services hosting for some DoD systems. On the flip side, it may be a plus that it is not behind your firewall, if you need users outside of your enterprise network to be able to access the LMS, and you don’t want to worry about security breaches by outsiders coming into your network.

Vendor-hosted solutions are often termed “SaaS” (software as a service) or “cloud” solutions, although this use of terminology can be confusing. SaaS or cloud can be used to refer to a disaggregated, Internet-

based collection of software services or components that make up an entire system such as an LMS. In practice, these services are almost always hosted on the vendor's server, but they could be installed within your intranet as a private cloud or custom-designed hybrid cloud (see section 4.9 *Security considerations for LMSs*).

Some of the advantages of a vendor-hosted platform are:

- Eliminates the cost of hardware and network infrastructure needed to support a local installation of the system
- Lowers your staff costs for administration and maintenance
- Puts less bandwidth load on the corporate network
- Content and feature updates can be accomplished without intervention by your staff
- Guarantees that system upgrades and patches are applied on a timely basis; most vendors upgrade their hosted installations on a monthly basis. Installation of updates on your server can lag significantly behind the vendor making them available, for a host of reasons.
- Having the vendor take responsibility for upgrades and patches avoids the headaches of reestablishing your integrations, etc.
- Enables faster implementation. This can be dramatic, for instance, 3 weeks for a vendor-hosted solution vs 6 months for a behind-the-firewall solution.
- Requires little or no internal technical support or development
- Provides incentives and guarantees for maintaining uptime (via financial penalties assessed against vendor)
- Potentially better bandwidth to remote locations, depending on the vendor's server architecture and network (e.g., "edge servers" that are positioned at network nodes that are closer to remote areas)
- Facilitates data center compliance (esp. in regards to data centers in foreign countries) since this is handled by the vendor
- Scales more easily to account for temporary surges in usage (due to new product releases, seasonal events, etc.), due to the typical centralized system architecture usually implemented by hosting vendors, with loads dynamically shared and balanced across customer implementations.
- By virtue of the vendor taking responsibility for scaling, it eliminates the need for you to commit to purchasing and maintaining additional servers and bandwidth that may be unnecessary to support normal load during non-surge times.
- Is often associated with a usage-based pricing model (see 4.4 *Pricing models*), which may be more economical
- Contractually, it can be easier to switch to another vendor or end a vendor relationship
- Eliminates problem of version differences of software platforms that the LMS may be dependent on. For instance, a situation where your company has not upgraded their Oracle license but your LMS vendor's new release depends on an upgraded version of it to run.

One of the main disadvantages of a vendor-hosted solution is that it restricts opportunities and scope for local customization (although this can be mitigated to some degree with skins. See 4.2 *LMS skins and templates*). Also, a vendor-hosted solution may not provide the level of security required by your organization, although vendor-hosted solutions are increasingly more secure.

The security issue relates not just to unauthorized access, but also the fact that you may be placing trade secrets and other intellectual property in your content outside of your firewall on the vendor's server, outside of your control. If your organization's policy prohibits this, a vendor-hosted solution will not be right for you. And a vendor-hosted solution is summarily ruled out if there is classified data stored in the content. See section 4.9 *Security considerations for LMSs* for more information on security issues.

Finally, for government entities, a vendor-hosted solution may not be an option since government rules tend to mandate outright ownership and control of systems, rather than an arrangement like a vendor-hosted solution that resembles leasing.

Most vendor-hosted solution scenarios involve a single instance of the vendor's software that is engineered to support multiple customers, rather than establishing a separate instance of the software for each customer. This enables efficiencies for the vendor whereby they can apply patches and version upgrades for many customers at the same time. This lowers the operational LOE for the vendor and allows them to focus more on developing their product. Vendor-hosted systems are vendor-maintained and managed with minimal intervention required by the customer, so much of the headache of deployment planning relating to upgrades of the software can be avoided.

Vendors who offer hosted solutions commit themselves to providing a robust hosting and networking infrastructure with uninterrupted access 24 /7 basis from any location. The system that they host must be scalable and have redundant backup and security. These are items for due diligence verification during the acquisition process, if you decide to buy a vendor-hosted solution. Guarantees of average percentage of uptime are often written into the LMS service-level contract. You may want to independently verify uptime using a Web monitoring service. These services monitor access from multiple global endpoints. If an issue arises, your mobile phone is texted. Some monitoring services are quite sophisticated. They can actually periodically read data-driven Web-page elements to validate site availability in addition to the back-end functionality.

Vendor-hosted solutions are generally more expensive (roughly 20%) because they require the vendor to assume responsibility for maintenance and administration instead of the customer.

Hosted solutions are becoming more popular, as evidenced by a survey of corporate LMSs (Vipond and Clary, 2016). This survey determined that more than one-half (57%) of organizations in 2016 use hosted LMSs compared with 50% in 2013. This report also said that one-third (31%) of organizations still locate their LMS on premises, maintained by their own IT staff. The report concludes that this is evidence of the continued dominance of hosted LMSs over on-premises LMSs for the last three to five years. Other sources such as UpsideLMS (2016) put the proportion of hosted solutions even higher, at 87%.

You might want to use a "try before you buy" approach by using a vendor-hosted solution for a while before you decide to buy the system. Also, consider a vendor-hosted solution that is metered (pay-for-use price) rather than flat license for a maximum number of users.

When considering a vendor-hosted solution, ensure that your organization isn't already licensing ancillary software that is needed to run your LMS, such as an Oracle database. The vendor-hosted solution provider will pass through their cost for this license, which duplicates your existing (usually significant) investment. This may make a hosted solution not cost efficient for you.

On 10/13/11, Pearson Inc. announced a free vendor-hosted LMS for higher education called "OpenClass". In order to support such a free service, Pearson hoped to be able to sell more of their content (that is optimized for the OpenClass delivery environment). However, this model of free vendor-hosted solutions (similar to other cloud-based software business models like Google) does not seem to be viable, judging by the fact that Pearson announced that they will remove the system on 1/1/2018.

You may want to consider outside hosting of particular types of content, especially video. For instance, YouTube® and Vimeo® allow you to upload videos, which you can then drop code into an LMS to launch.

SoundCloud® can do the same thing for audio. Note that some corporate networks do not allow employees to access these sites, however. Also, even if you do not use these sites, there may be considerations regarding the video player, such as level of permissions for user groups, level of user authentication, and security of delivery of the video stream. This applies particularly with employee-generated video sharing environments. If there are concerns about privacy, security, and ownership of videos, video streaming is an important requirement; it prevents videos from being downloaded into the viewer's computer.

Be careful about free cloud-based LMS-like service providers such as Facebook®. Read the terms of service carefully. There will undoubtedly be advertising, and you will need to determine how much is too much. Hidden features could include the provider selling your user lists to headhunters or spammers. Content may transfer ownership to the provider once uploaded. If you are charging your users for access, then you will probably need a commercial license.

Note: Vendor-hosted solutions are sometimes called “ASP” (application service provider) solutions. Do not confuse ASP with Active Server Pages, a web programming script.

4.11 Multiple LMS providers

Given the high cost of LMSs, and their claim to be “one-stop shops” and “one size fits all” vehicles for enterprise learning needs, it may seem strange that some organizations have more than one LMS product from more than one provider. In some cases this is simply due to a long migration period from one product/vendor to another, with subsequent overlap in ownership, or some user group refusing to let go of their familiar LMS (with funding to support it) while it has been replaced for most other users. However, this is more and more indicative of a “learning environment” approach, where the organization acquires multiple specialized LMSs that act in concert to provide particular needed capabilities that a single “one size fits all” LMS (which spreads its capabilities thinly thus not very robustly) cannot provide.

Vipond and Clary (2016) report that even though most organizations (62%) rely upon a single LMS provider, one-fifth (20%) use two providers. This has not really changed since their 2013 survey, however, they conclude that, “The multiplicity of LMS providers is accelerating, and the marketplace is becoming more fluid as LMS providers operate across more than one market. This makes things more confusing for organizations that are seeking to upgrade their core learning management capabilities and survive the sometimes long period of transition from an older legacy LMS to a feature-rich LMS now entering the marketplace. Having numerous different LMS providers also impacts customer loyalty and satisfaction.” (p.3)

4.12 The cross domain issue

For some time, browsers have incorporated a security feature that prohibits a server with which it is communicating to connect directly to a server on another domain. When users point their browser to a server on a particular domain, there is a presumption of trust, and explicit choice to pull in content based on that trust. If that server unilaterally and unbeknownst to the user gets content (especially client-side scripts) from another server on another domain (that is not necessarily trusted), a hacker who has co-opted the second server can send harmful code to users by passing it through the primary trusted server. See http://en.wikipedia.org/wiki/Cross-site_scripting for more details on this issue.

Barring using a workaround like those listed below, the cross domain issue requires you to have your content stored on the same domain (i.e., server, usually) as the LMS. In other words, if the LMS is at www.myLMS.com, the content cannot be at www.myContent.com; the content must also come from www.myLMS.com.

This problem comes up most often in LMS implementations where there is a separate content repository server at another location from the LMS; this content repository server might be another enterprise server,

or it could be a repository of commercial content behind another commercial entity's firewall. The cross domain security feature prohibits accessing the content that is on a separate domain from the LMS.

Even if it were not a problem for the user to be able to access and launch the content directly from its content repository on the other domain (perhaps through a separate LMS), the problem remains of communicating tracking information (e.g., course completion status, assessment scores, etc.) to the initial LMS.

There are several workarounds to the cross domain issue:

- Allowing the primary server to serve as a proxy to the server on the other domain (see <http://developer.yahoo.com/javascript/howto-proxy.html>).
- JSONP (see <http://en.wikipedia.org/wiki/JSONP#JSONP>).
- Cookie security (see http://en.wikipedia.org/wiki/Cross-site_scripting#Mitigation).

4.13 Special requirements for U.S. DoD

The DoD Information Assurance Certification and Accreditation Process (DIACAP) is the DoD process to ensure that risk management is applied on information systems. It certifies and accredits a DoD information system to maintain the proper information assurance (IA) posture throughout the system's life cycle. If you are acquiring an LMS for a U.S. DoD organization, it is important that you check the DIACAP certification status of any LMS you seek to acquire. Also, DIACAP may require you to have your LMS hosted at the Defense Information Systems Agency (DISA) facility, not at your facility (and not hosted by the vendor, either).

You may be subject to Service-specific requirements. These requirements speak to the “fit” of the system to the enterprise architecture of the organization (in this case DoD). These cover requirements such as:

- Security
- IT environment
- Specific use case testing
- Training gap/training needs analysis capability

Each Service often has their own training records system that the LMS needs to integrate with. For instance, the Navy often requires the LMS to integrate with NTMPS (Navy Training Management and Planning System) for personnel information and training records.

One requirement that is fairly consistent across the Services is that the LMS must interface with DEERS (Defense Enrollment Eligibility Reporting System) for user verification and registration information. Another requirement across Services that may apply is that any competency management module must be compliant with Common Human Resource Information Standards (CHRIS).

There may be particular implementation issues when installing an LMS in U.S. DoD or government, such as:

- Requirements for conducting site or pre-installation surveys
- Constraints on who can host the LMS
- Hardware, software, and firewall requirements
- Particular government contracting rules regarding setup, startup costs, vendor support, and annual maintenance agreements

See *Appendix D: Sources of Possible Requirements for U.S. DoD LMS Acquisitions and Installations* for a list of possible sources of requirements for U.S. DoD.

4.14 System environments

It is important that you institute at least two and possibly three staging environments for your LMS, possibly on separate networks. When acquiring an LMS, you should take this into account. Consideration of multiple environments (i.e., instances of the software installation) is often an oversight until after procurement (at which point there are financial barriers to implementing it). The environments are:

- **Development** – for content developers to upload, configure, and test their content, and for administrators to perform “what if” scenarios for major changes to the system.
- **Test** (also termed **Stage**) – for content and major configuration changes made in the Development environment to be verified and finally approved before being migrated to the Production environment. This instance of the system should exactly match the Production system in all respects. This environment could be the same as the Development environment. However, you may want it to be different (i.e., Test as described here) so that you can more flexibly make configuration changes to the Development environment to accommodate the needs of testers and developers.
- **Production** – The live system that learners and administrators use.

These environments do not have to be separate installations. Isolated areas or instances of one installed system can be just as effective; however, firewall restrictions and different access needs for the user groups associated with each of these environments may prohibit this, requiring separate installations.

Acquisition of these environments in addition to your production environment will probably affect pricing and your infrastructure requirements. Licensing can be complicated if external entities such as content development vendors need to use the additional instances. Special licenses may be required for them. Some LMS vendors sell packages that include these staging environments pre-configured (“sandboxes”).

You need to be careful about allowing testing of new LMS versions/features/customization and testing content on the same environment or instance of it. This situation can lead to problems, where, for instance, content works well in the Test environment, but not in the Production system because they are not precisely the same.

4.15 Standards support

4.15.1 SCORM

4.15.1.1 Overview

ADL has identified the following high-level attributes for all distributed learning environments.

- **Interoperability**: the ability to take instructional components developed in one system and use them in another system.
- **Accessibility**: the ability to locate and access instructional components from multiple locations and deliver them to other locations.
- **Reusability**: the ability to use instructional components in multiple applications, courses and contexts.

- **Durability:** the ability to withstand technology changes over time without costly redesign, reconfiguration or recoding.

To achieve these attributes in distributed learning environments, ADL promotes the use of the Sharable Content Object Reference Model (SCORM®). SCORM defines the interrelationship of course components, data models, and protocols so that learning content “objects” are sharable across systems that conform with the same model. To support interoperability, SCORM standardizes the means of communication from the sharable content objects (SCOs) to the LMS, through an Application Programming Interface (API) and prescribed data model elements.

For more information on SCORM, see <https://www.adlnet.gov/scorm/>

It is important to understand that SCORM neither dictates nor precludes any instructional, performance support, or evaluation strategy. SCORM does enable object-based approaches to the development and presentation of eLearning. This is enabled by aggregating learning content composed from relatively small, reusable content objects to form meaningful units of instruction. Individual content objects can thus be designed for reuse in multiple contexts, and aggregated variously to assemble new components and programs of instruction.

This object-based approach, intended to support reuse, means that content objects must not determine by themselves how to sequence/navigate aggregations that represent parcels of instruction. Doing so would require content objects to contain information about other content objects, which would inhibit their reusability. ADL addressed this requirement by standardizing a set of behaviors that all SCORM-2004 compliant LMSs must support. Thus, the LMS, rather than the content, controls the movement of learners from SCO to SCO.

To support reuse, SCORM uses metadata to enable content objects to be discoverable through and across enterprises, within distributed content repositories.

NOTE: LMSs for U.S. DoD installations must be SCORM-conformant (to the “current version”) according to DoD Instruction 1322.26 (June 16, 2006 – this DoDI, as of this writing, is being revised, although it is likely that this requirement will still remain in effect). See <http://www.dtic.mil/whs/directives/corres/pdf/132226p.pdf> for more details.

4.15.1.2 Requirements for SCORM support

For an LMS to robustly support SCORM, it must:

- Support SCORM-conformant learning delivery
- Support all SCORM data model elements (SCORM 2004)
- Import SCORM course packages
- Support SCORM metadata
- Support sequencing and navigation rules for the course organization (SCORM 2004)

If you expect to deliver legacy SCORM 1.2 content, you should ensure that the system supports it; SCORM 2004 is not backwards compatible with SCORM 1.2, so the LMS needs to include separate functionalities for importing, configuring, and delivering these two standards (generally, when you import SCORM content into the LMS, there will be separate options for SCORM 1.2 and 2004).

Before you evaluate the LMSs in terms of SCORM compliance, you should determine the target SCORM compliance level (for example, SCORM 2004 4th Edition). This depends on the compliance level of your legacy courseware, and courseware you plan to develop. LMSs can lag several versions behind the

current level, and since SCORM levels are not all backward compatible, it is important to determine the level of compliance needed for your course delivery system.

SCORM comes in five versions:

- SCORM 1.1
- SCORM 1.2
- SCORM 2004 2nd Edition
- SCORM 2004 3rd Edition
- SCORM 2004 4th Edition (the current version)

Conformance with SCORM 1.2 is broken down into three levels, LMS-RTE1, LMS-RTE2 and LMS-RTE3. The levels indicate how much of the SCORM run-time data model the LMS supports. LMS-RTE3 indicates full support.

ADL highly recommends that you acquire a sample SCORM-conformant eLearning course produced by the authoring tool you use, and test it on the LMS you are evaluating for purchase. LMSs implement the same SCORM compliance level differently in some cases; the interaction of the particular implementation of SCORM in the LMS and the particular implementation of SCORM in your SCORM course package, even if both are at the same level of compliance, may uncover issues. This may impact your decision to purchase a particular LMS.

4.15.1.3 SCORM Conformance vs Certification

An LMS that is SCORM conformant has been tested in the ADL SCORM Conformance Test Suite to ensure that it performs as specified by the SCORM standard. This test applies to a specific version of SCORM only. The ADL SCORM Conformance Test Suite is available at http://adlnet.gov/wp-content/uploads/2011/07/SCORM.2004.4ED.TS_v1.1.1.zip.

An LMS that is SCORM certified means that a qualified, neutral third party has conducted a formal evaluation using the ADL SCORM Conformance Test Suite using a rigorous, accurate, reliable, validated methodology. Certified products display the ADL certified product logo. There is a list of SCORM-certified LMSs on the ADL web site at <http://adlnet.gov/wp-content/uploads/2013/09/SCORMCertifiedProductsLocked-5.xlsx>.

If you are considering products that claim to be SCORM conformant but are not SCORM certified, you should ask for an ADL SCORM Conformance Test Suite test log from the vendor verifying their SCORM conformance. Alternatively, you can run this test yourself if you have access to a version of their LMS. A product that cannot pass the full set of conformance tests is not SCORM conformant.

ADL recommends that you write into your contract or acquisition language that the vendor will maintain SCORM conformance/certification throughout the life of the contract. You do not want to be stuck in a situation where the vendor issues a patch, upgrade, or new release that interferes with the ability of the LMS to deliver SCORM, and your SCORM content suddenly does not run properly (with no recourse to force the vendor to fix the problem).

Be aware that, in the past, there have been loopholes in the certification process whereby vendors can maintain their SCORM certified status, even though their LMS has undergone version upgrades, patches, etc. that inadvertently affect their SCORM engine, with the result that SCORM content no longer works properly in their LMS. ADL is revising the rules for the certification program to address this loophole.

Dig deep into claims of SCORM compliance. If the LMS has an internal authoring tool, it may mean that the product can import a SCORM package into the authoring tool, but the authoring tool converts it into the LMS's proprietary format in order for it to work in the LMS. In other words, you may not be able to

import SCORM content directly into the LMS and have the content function natively (using SCORM affordances) within the LMS. This is not true interoperability in the spirit of SCORM.

You may want to ask the vendor whether they participate in the process of evolving the SCORM standards, and if so, how. ADL has a variety of community outreach avenues that enable vendors to share suggestions and keep abreast of SCORM developments. This is a good indicator of the vendor's commitment to support for the SCORM standard.

4.15.2 Section 508

The U.S. Rehabilitation Act of 1973 was amended in 1998 to add Section 508, which establishes rules, principles, and guidelines to make it easier for people with disabilities to access electronic and information technology media. The law applies to all Federal agencies when they develop, procure, maintain, or use electronic and information technology.

If your organization requires Section 508 compliance for eLearning systems, it is critical that you include this as a decision parameter in your choice of an LMS. Do not confuse Section 508 compliance for the LMS with Section 508 compliance for the content; 508 compliance for the LMS means that the interface and navigation through the LMS is accessible to those with disabilities (especially visual impairments). Where 508 compliance is required, the content must also be 508 compliant, but LMS compliance does not affect or control this.

You should verify 508 compliance by testing the LMS with screen reader software used by those with visual impairments and/or using an independent accessibility checker.

For references and other information on Section 508 compliance, see <http://www.section508.gov/>

4.15.3 Aviation Industry CBT Consortium (AICC)

Support for this popular legacy standard is fairly common among LMSs. Note that the standard is used by many more organizations than the aviation industry. One reason for the popularity of the AICC standard for content is that it avoids the cross domain scripting problem (see 4.12 *The cross domain issue*). There are several different implementations of AICC:

- File-based
- HTTP (Web)-based
- ECMAScript-based (browser-based)

In most cases, the term “AICC” refers to the HTTP-based implementation known as HACP (HTTP AICC Communication Protocol). If AICC support is important to you, you may want to ensure that it supports HACP to ensure broad content compatibility.

NOTE: AICC as an organization dissolved in 2014 and transferred its CMI-5 standard and document archive to ADL. The CMI-5 standard has adopted ADL's xAPI specification. For details on CMI-5, see https://github.com/AICC/CMI-5_Spec_Current

4.15.4 Standards for metadata

Some of the standards that are used specifically for metadata in eLearning are the following:

- IEEE Learning Object Metadata (LOM)
<http://www.imsglobal.org/specifications.html>
- Dublin Core
<http://www.dublincore.org/>

Support for a particular metadata standard in an LMS is not needed unless the standard has been fully adopted by your organization. If the metadata standard has been adopted, LMS support for it will facilitate search, discovery, and cataloging of your eLearning and other content objects in your LMS. In a large enterprise with many learning objects, this may represent a significant savings of time and effort. Metadata normally resides within the content itself and is imported into the LMS database when the course files are imported.

Note that SCORM does not prescribe use of metadata, or any particular metadata standard. However, LOM is most commonly used.

4.15.5 Learning Tools Interoperability™ (LTI)

The IMS Global Learning Consortium developed LTI as a standard way of integrating rich learning applications with LMSs and other educational environments. In LTI these learning applications are called Tools (delivered by Tool Providers) and the LMS, or platforms, are called Tool Consumers. For more information, see <http://www.imsglobal.org/toolsinteroperability2.cfm>.

4.15.6 Common Cartridge®

IMS Global Learning Consortium developed Common Cartridge® as a standard way to package a course for importing to an LMS. It has many of the same advantages as the SCORM packaging specification (Content Aggregation Model). If you are importing and delivering courses that are packaged using this specification, you need your LMS to support it. See <http://www.imsglobal.org/cc/index.html> for details on this standard.

4.15.7 QTI®

The IMS Question and Test Interoperability specification (QTI) is an interoperability specification that specifically relates to online tests. It is concerned with the structure and display of test items as well as results. It allows passing of data between authoring systems, content, and delivery systems, including LMSs. See <https://www.imsglobal.org/question/index.html> for details on this standard.

4.15.8 ADL Total Learning Architecture (TLA), including xAPI

ADL has termed the next generation of SCORM as the Total Learning Architecture (TLA). All current and planned future ADL technical projects, specifications and standards efforts fall within the scope of the TLA, an umbrella term that covers projects designed to create a rich environment for connected training and learning. Phase I of the TLA is focused on experience tracking that includes these four areas:

- A new runtime API
- A new data model
- A new data model format/syntax
- A new transport/communication method

The overall TLA vision also includes concepts for learner profiles, competencies, and intelligent content brokering to meet the needs for individualized learning content and systems. The TLA is not intended to replace SCORM, but SCORM, and multiple other types of content formats, will work in the TLA. The four major areas of innovation of the TLA are:

- Experience tracking
- Learner profile
- Content brokering
- Competency infrastructure

The Experience API or xAPI (formerly known as the ‘Tin Can API’), the “experience tracking” component described above, is the farthest along in development currently (version 1.0 was released 4/26/13, and the spec is now at version 1.03). The xAPI tracks both formal and informal learning via ‘streams’ of learning experiences, similar to social media streams such as Twitter and Facebook. By capturing learning experiences via streams, learning can be mashed up with other activity data to fully analyze how it ties to performance. The new xAPI (see <http://adlnet.gov/adl-research/performance-tracking-analysis/experience-api/>) enables the use of mobile devices, games, social networks, virtual worlds, and simulations in learning and training environments with the ability to track learning experiences consistently across devices and platforms. You could report that ‘David watched a video,’ ‘David rated a video,’ ‘David tweeted a video,’ and ‘Jane retweeted David’s video.’

Learning can also be tracked in real life situations and reported the same way. For example, ‘John produced an audio track for a video,’ ‘Steven edited a video,’ ‘Ralph posted a video,’ and ‘Mary earned an Academy Award for a video.’ This is why this is described as “connected” learning, because even “real life” situations can be connected in more ways than just how people interact with computers on the Internet.

The xAPI is a specification that describes an interface and the storage / retrieval rules that developers can implement to create a learning experience tracking service. The service works by allowing statements of experience (typically learning experiences, but could be any experience) to be delivered to and stored securely in a Learning Record Store (LRS). Widespread adoption of the xAPI may drive LMSs to include an LRS component that can handle xAPI statements.

One major advantage of the xAPI over SCORM is that it does not require launching content from an LMS; in fact, it does not even require Internet connectivity while the user is engaged in the learning experience. Learners can connect after the fact to allow the xAPI to synch the records of their learning experiences. This has obvious implications for the future of LMSs; to accommodate learning that is developed for use outside of the LMS environment, or disconnected use, LMSs may need to separate their function that handles tracking of learner experiences into a single cloud-based service (in xAPI terms, an LRS) that is easily accessible from a variety of content and can dynamically capture xAPI statements describing learning experiences. See 7.26 *Is the traditional LMS dead?* for more information on the implications of xAPI on the LMS.

For information on the xAPI standard, see <http://adlnet.gov/adl-research/performance-tracking-analysis/experience-api/>. There is a list of current adopters of the xAPI at <http://adlnet.gov/adl-research/performance-tracking-analysis/experience-api/xapi-adopters/>. A white paper similar to the one you are reading has been produced by ADL, called *Choosing an LRS* (Berking, 2015b), available at <https://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAnLRS.docx>. Learning Record Stores (LRSs) are the system necessary for receiving xAPI statements (that are now being integrated into or with LMSs).

Also see 7.1 *Experience API (xAPI) adoption* and 7.26 *Is the traditional LMS dead?* for more details on how the xAPI is affecting LMSs.

4.16 Internal assessment authoring

ADL recommends that you create assessments within the content so that they are portable and interoperable; however, in some cases, you may want to be able to create assessments through tools offered within the LMS. The vast majority of LMSs offer internal assessment creation and delivery capabilities. The downside to using this internal authoring function for assessments is that these assessments are often permanently resident in the LMS and cannot be exported for use in another system or with other content.

Assessment authoring within the LMS may be attractive because assessments must interwork closely with the LMS tracking database. For instance, an assessment created in the LMS may allow a greater range of

reports. It is often quicker and easier for LMS instructors and administrators to use an internal LMS function rather than create external assessments with the appropriate data calls. Also, assessment interactions can be more difficult to program than presentation content, so it avoids this technical burden on the customer as well.

Use of internal assessment authoring is particularly common in cases where learning activities are conducted offline and cannot be assessed and tracked by the LMS while the learner completes them. Thus, an LMS-delivered assessment capability or assessment management system such as Questionmark® is the only way to verify and store the learner's progress against outcomes, and it is easier to author these assessments internally in the LMS. The standard types of eLearning assessments that are offered are:

- Multiple choice (both single and multiple answer)
- Fill in the blank
- Matching
- Drag and drop
- Ranking/Ordering
- Image selection
- Essay or Short answer (this usually requires instructor intervention to score answers)

Some LMSs import and export assessments that adhere to the QTI® specification (described in 4.15.7 *QTI®*), which allows portability of the assessments between systems.

4.17 Internationalization

If your learners include international audiences (especially including foreign language speakers), you will need to consider features of the LMS that will support it, as well as plan your LMS implementation accordingly. There are many factors you may need to consider, in addition to language, such as:

- U.S. export laws governing dissemination of information in areas of technology that is deemed of strategic importance to national security (this applies to information that is not classified or marked as FOUO)
- Local government rules and regulations that may lead to non-compliance of content
- Government requirements for training record storage
- Accreditation differences
- Cultural norms
- Local and country-wide IT environment
- Currency and currency exchange, and financial market operation, if charging money for training.

4.18 Instantiation for individual business units

Many LMSs are adding the ability of a single enterprise LMS to create a customized interface and some degree of local control of administrative functions for different business units, divisions, workgroups, etc. within the enterprise. This has the effect of allowing these groups to have their own interface look and feel, course catalogs, etc., giving the appearance that they have their own LMS. It also may allow them to customize the administration of their “storefront” to some degree. This instantiation is usually implemented via login profiles, such that when a user from a certain organization logs in, the interface, available courses, global functions, etc. are delivered as configured for that organization. See 4.2 *LMS skins and templates* for more details.

This instantiation is normally used in cases of LMS sharing (see 4.19 *LMS sharing*).

4.19 LMS sharing

The driver for the popularity of instantiation of an LMS for individual business units (see 4.18 *Instantiation for individual business units*) is mostly economic; it allows an enterprise (especially a large one, like the Federal government) to save money through sharing of the same system, rather than each unit, agency, etc. having to purchase a separate system. There are two ways LMS sharing can be achieved: one is where an organization is paying for a greater capacity on an LMS than they are using, and another organization can fill that capacity up to (but not over) that maximum. This can result in no extra cost to either organization except for the maintenance and administration associated with using that larger capacity. This arrangement is enabled by a seat-based pricing model (see 4.4 *Pricing models*) and a license with the LMS vendor that allows the purchasing organization to share with other organizations.

The other arrangement is necessary where there is not enough unused capacity. In this case, the LMS purchaser organization buys more seats or a higher capacity tier on an LMS, with the organization using the higher capacity covering the cost. This can be highly economically advantageous for the organization using the higher capacity, since it is almost always a net savings in cost to share an existing LMS in this way rather than buy a separate product or hosting package from the vendor. This arrangement can be used when the pricing model is either seat-based or usage-based (see 4.4 *Pricing models*) and is also subject to licensing rules.

An example of an LMS sharing plan offered for government organizations is the USALearning Knowledge Portal, run by the Office of Personnel Management (OPM). See <https://usalearning.gov/> for more information.

4.20 The path of least resistance

It is important to remember the simple fact that most users, in many cases regardless of their skill set, will follow the path of least resistance in using an LMS, as with any other software. In other words, users will gravitate towards the most heavily optimized system features—those that are prominently available in the interface and easiest to manipulate. The system may include many advanced capabilities, or even easy workarounds or hacks that are possible to accomplish highly time-saving tasks, but most users will ignore these if they are not designed to follow the path of least resistance.

So the question in evaluating an LMS is not necessarily, “What can the system do?” but, “What can the system do in a right-out-of-the-box, plug-and-play, easiest/most-obvious-path use case scenario?” Just because a vendor is able to make a technical case that their system has a particular capability doesn’t mean that it is implemented in a way that is easy for users to see, understand, and use.

4.21 Aligning staff and processes to system capabilities

As with most software, systems that are easier to learn and use generally have fewer capabilities, and vice versa. Sophisticated capabilities will generally require a system that is harder to learn and/or require specialized professional expertise. It is important to determine the skill sets within your pool of LMS administrator staff, so that you know what you are prepared for and/or what you might have to acquire in terms of staffing or training. You can engineer your staff expertise and roles to match the out-of-the-box system, but it is usually not cost-efficient to engineer the system to match staff expertise.

This also applies to task flow; you will almost invariably need to decide whether you want to change your internal processes to match the built-in LMS task flow, or vice versa (i.e., reengineer the LMS to match how your organization does things). This is a complex issue, and there are some strong proponents on the side of choosing an LMS that, out of the box or perhaps with customization, supports your existing processes, but this may be easier said than done. It is likely that you will have to do some of both. Above all, do not underestimate the financial pressure you may find yourself under to tailor your organizational

policies and processes to make it easiest to work with the system out of the box. Customization of LMSs, whether open source or commercial products, can be quite expensive, and it should not be undertaken lightly even if not expensive; if you start making changes to the guts of the system, you may quickly reach a point of no return where system updates from the vendor are incompatible with your customized system, thus your system cannot be upgraded (it behooves the vendor to warn you about this).

The LMS system design and “path of least resistance” workflows can imply changes to your existing processes and infrastructure in the following areas:

- IT infrastructure
- Administrative procedures and policies
- Workplace cultural attitudes and ingrained practices
- Training paradigms

4.22 Planning for operation and governance of your LMS

Before acquiring your LMS, you should have a preliminary plan for how you will ensure smooth operation of it so that it will be used to its full potential and will address the performance gap that led to your decision to acquire it. You also want to be clear on who will maintain both the system and the content it contains, to avoid confusion and institutional obstacles that could affect the ability of the system to realize its intended mission throughout its lifecycle. Without this preliminary plan, you may face skepticism from management approvers of the acquisition.

This preliminary plan will probably change once your system is fully installed, after you gain some familiarity with it and better understand how to leverage the system features to best express your business needs, processes, and policies. The reverse applies as well as well; you may determine that it is easier to change your processes and policies to match the system’s standard features and workflows, as described in 4.21 *Aligning staff and processes to system capabilities*.

To ensure a smooth implementation, you need to start this planning during the acquisition phase, not wait until after acquisition. Some aspects of your plan may impact your choice of LMS and vendor, especially if the vendor will act as implementation consultant.

According to Foreman (2013), the following areas should be addressed in your LMS Operation and Governance Plan:

- Standards
 - Policies
 - Content inclusion policy
 - Content ownership policy
 - Content lifecycle policy
 - Training information retention policy
 - Procedures
 - Guidelines
 - Conventions
 - Standards for course properties
 - Standards for course structures
- Taxonomy
- Configuration Management
- Housekeeping

- Governance
 - Governing board
 - LMS steering team
 - LMS working groups
 - LMS operations
 - LMS operations management
 - Content owners
 - LMS administrators
 - Technical support

4.23 Data migration

If you are switching LMSs or moving data into a new LMS from an HR system, you will need to plan carefully for data migration. The goal should be no loss or corruption of data in the process. You may not need to migrate all data; some of it can be archived and accessed only if and when needed. Be careful in making this decision, however. Some of the data that you need to keep may have dependencies on data that you might otherwise archive, for example, course prerequisites.

In many cases there is no way to avoid some degree of manual data recreation; automated tools would be prohibitively expensive to develop. There are four categories of data that you may have to migrate:

- **Content.** An analysis of how the new LMS stores and delivers content differently might uncover discrepancies that have to be addressed by modifying content or even converting it to another format, which can be costly. Data mapping, data cleaning, content ownership, and content portability are important issues that may need to be addressed.
- **Logical entities.** This includes logical entities stored in the system like learning paths and certifications. The mapping from the old system to the new could be complicated due to different databases, definitions, dependencies, and rules. Moving these to the new system will probably involve recreating them in the new system.
- **Training records.** These are the records (i.e., transcripts) of all training sessions. It includes not only past records, but in progress training as well.
- **User-generated content.** There may be types of content related to peer to peer sharing in the old system that need to be migrated. This includes discussion forums, chat rooms, expert exchanges, etc., as well as documents and media files generated by users stored in content repositories.

An important factor to consider in data migration is standards. Your migration may go smoother and you will have more flexible data if you convert your legacy data to standards such as SCORM or LTI and then have the target LMS ingest it according to the way it handles data formatted to these standards, rather than do a straight database to database exchange. For SCORM courses, Foreman (2013) describes the following process:

- Categorize the SCORM courses by the authoring tool or vendor that produced them
- Then install and thoroughly test one course from each category
- Test course launch, player compatibility, bookmarking, navigation, audio, video, animations, graphics, and embedded links, as well as test score, and module and page tracking
- Make sure the course shows up properly in the transcript of the new LMS
- If you run into problems, make any needed adjustments to the course and the manifest, reinstall and retest
- Replicate your adjustments to all other courses in the category; install and test them all.

- Manage an exception list of any courses that don't work properly
- If you no longer have the source code for the course, you may need to redevelop the course using a more compatible authoring tool

In many cases, the vendor of the new LMS will have dealt with a range of migration issues within their customer base and have solutions developed that can save tremendous amounts of time and headache. Talk to your vendor to explore options that are available.

4.24 System load and bandwidth to the users

For many organizations, load on the LMS system itself may not be an issue except perhaps during peak usage times. There are various possible solutions to this problem outside of simply buying increased system capacity; a simple one is to stagger course completion deadlines between courses or groups within a course such that the users are not piling up on the server all at once. Content delivery networks (CDNs) can be helpful in these cases as well (see 7.18 *Content delivery networks (CDNs)*).

However, network bandwidth to the users to and from the LMS server could be a problem, especially if they are in remote areas or using BYOD data plans on mobile devices. There could even be a problem within retail outlets, where employees taking training onsite at the outlet are sharing bandwidth with point-of-sale (POS) systems, security systems, customer Wi-fi, etc. With greater and greater use of video (especially high definition) for training, there could be a significant slowdown for all users within the store. This could cause problems for not only trainees who experience latency in their training videos, but for customers trying to complete purchases, etc. in the store.

Provisioning content to the local site or end users in advance could be a solution to bandwidth problems, so that the download of content media is done at an optimal time and place and is stored for use when needed later. See 4.8 *Offline content provisioning and player capability* for more information.

Your IT department needs to look carefully at the impact of delivering different kinds of content (esp. video) from the LMS, the logistics of how and where training is taken by users, and a host of other issues so that your LMS initiative is not doomed from the start by low bandwidth to the trainees, or the corporate repercussions of slowing down operations.

5. List of possible requirements for an LMS

This section contains a comprehensive list of possible requirements for an LMS you are acquiring. It could also be used to assess the quality and suitability of an LMS. The applicability of items in this list to your situation will probably vary widely; some items may be mission-critical for your organization and some may not be pertinent at all. You need to carefully weigh the importance of each in evaluating LMSs. If you rate your list of LMS candidates simply by items in the list without weighting each item for its importance to you, it could skew the results, which could lead to a poor final choice for your system. A table in *Appendix B Sample System Features Rating Matrix* allows you to set weightings for your requirements and calculates a score based on them.

There is also the issue of the degree of support and robust implementation for a certain LMS feature. Very few of the features listed below are a strict either/or proposition for being present or not in a given LMS. They are implemented in various degrees of power, flexibility, usability, scale, etc. The devil is in the details of a given LMS feature in terms of nuances and variations in the way different systems implement it. These can make the difference between a feature being truly usable or not.

Because LCMSs incorporates additional content authoring and repository functions, other requirements are applicable for LCMSs in addition to the criteria presented in this section. See *Appendix G: Additional requirements for LCMSs*. Further, if you are looking at an LCMS solution, you will need to focus on the quality of content authoring features. For a list of quality criteria related to authoring capabilities, see

ADL's *Choosing Authoring Tools* paper at <http://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAuthoringTools.docx>.

The following is a list of possible requirements, which can also be used as a standard reference for assessing the quality of an LMS. Some items on the list below are stated in a way that can be subjective. Meeting these requirements requires a qualitative assessment of how well specific features in a given product address the stated requirement, with a rating assigned. However, most of the items in the list are specific and can be basically determined as being present or not, in “yes” or “no” form, in a given product (though still subject to some degree to quality of implementation details, as discussed above).

Requirements are grouped at the highest level under major functional LMS areas; note that these functional areas are not mutually exclusive and sometimes overlap. Generally, however, we avoided listing requirements in more than one functional area, so that the overall list contains no repeated items.

5.1 Registration and enrollment functions and workflow

- Uses a straightforward, simple process for administrators to manage registrations and enrollment
- Incorporates navigation and search options within course catalogs and learning tracks to find and register for courses
- Allows secure self-registration process for external users (who are not automatically registered by virtue of being an employee)
- Allows administrators to easily combine and un-combine course sections
- Allows learners to auto-enroll for courses
- Automatically places learners in wait lists if courses are full, with automatic notification to affected stakeholders
- Automates tuition assistance requests and allow for supervisor and other administrative approvals of these in the system. This includes automating tuition assistance verifications after courses are completed.
- Provides the ability to restore learner artifacts and records in a course if a learner who has withdrawn subsequently re-enrolls
- Manages registration and enrollment not only by individual, but by group and cohort
- Provides the ability to print a variety of enrollment-related items, including class schedules, seat vacancies, and class rosters
- Allows a variety of billing options: credit card, corporate purchase orders, departmental account numbers, etc.
- As a configuration option (where courses are not mandatory), allows learners to select, register and remove courses or curricula from their course listing/learning track on their own with no supervisory or administrator intervention
- Displays visual interface options such as map and tree metaphors to enable clear understanding of the organization of curricula and easy course selection within them
- Provides the ability to “crosslist” courses. “Crosslisting” is a process for manually sharing courses or learning objects within them without creating multiple instances of the same course. For example, a course might have two names, since learners can get credit for it while in two different curriculum tracks (e.g., anthropology and sociology); enrollments will be different, tied to the different curriculum tracks, but learners will be taking the same course.

- Allows registration and enrollment based on multiple memberships. For instance, a user is a member of the HR division but also a Level 2 supervisor; they are assigned courses based on both of these memberships.
- Manages recurring training such that learners are auto-enrolled at the appropriate intervals
- Allows training managers and instructors to enroll and/or approve enrollments for learners. Approvals should have due dates associated with them.
- Saves sets of configurations as templates that can be applied to future courses
- Routes enrollment requests to and from appropriate parties with notification to others: administrators, instructors, students, and stakeholders
- Allows automated identification, disabling, and archiving of learner accounts and course sections that have been inactive for a set amount of time
- Interfaces effectively with HR systems to provide user lists, to automatically add new users and deactivate users who have left the organization. Manual maintenance of user lists can be labor-intensive and complex.
- Provides links to and/or enrolls learners in appropriate courses or curriculum automatically based on organizational requirement settings
- Allows guest (i.e., non-credit) access to courses
- Can flexibly store and report course credits in different number formats, from whole numbers down to decimal places. Some organizations that license and certify professionals offer courseware that needs to be tracked at the level of two decimal places, for example, 2.75 credits.
- Allows setting course allotments and prioritizing learner enrollments to courses based on them
- Includes instructor cadre management. This includes managing instructor qualifications, classes authorized to teach, and resource alerts to prevent over-booking in scheduling.
- Allows administrators to easily override settings made for groups to account for particular training needs of individuals

5.2 Notifications, messages, and annotations

- Notifies users when actions are taken in the system that affect them, both through internal system notification functions and by email. Notifications can be triggered by such actions as:
 - Change in user profile status
 - Change in course status
 - Confirmation of enrollment
 - Class cancellation
 - Being wait listed for a course
 - Learner dropped from class
 - Periodic reminders to attend or finish courses
 - Reminders to complete a survey
- “Canned” notification email messages can be customized using a combination of free text and system variables. Fields that may be customizable include:
 - Recipients

- Subject
- Body
- Signature
- Course title
- Course dates
- Course location
- A notification history function is included.
- Notifications and calendar events for learning events and deadlines can be inserted into web-based e-mail calendars, like Gmail and Hotmail..
- Allows pushing of general notifications out to only specific groups
- Sends reminders to students and stakeholders about certifications that are about to expire (so that they can take actions to renew)
- Provides the ability to annotate and communicate actions taken, approvals, errors, etc. in regards to administrative actions, for future reference or for other administrators
- Has internal email or message editor with features resembling standalone email programs (such as Outlook)

5.3 Batch administration workflow

- Offers batch options for tasks involving groups of system objects
- Allows setting up sequences of individual system processes to enable complex batch operations
- Allows administrators to batch register groups of learners
- Allows administrators to create backups in batch
- Allows administrators to batch set permissions and roles for users
- Allows administrators to batch configure courses, learning tracks, and curricula
- Allows time shifting of batch processes of database or processor-intensive tasks to minimize performance disruption during peak usage times

5.4 Prerequisite handling

- Allows administrators to set prerequisites so that learners are evaluated for meeting prerequisites before being able to enroll in a course
- Can be configured to deliver pre-assessments to allow learners to “test out” if they demonstrate mastery of the material for a course
- Includes options for waiving course/curriculum requirements based on demographic attributes other than course completion or pre-assessments
- Establishes equivalencies so that learners can receive credit for courses and/or waive the requirement to take courses that cover the same material as a course already taken

5.5 Content importing and configuration

- Provides the ability to internally create and/or configure ancillary learning objects like glossaries that can interwork with courses and apply globally to more than one course within the LMS
- Is interoperable with 3rd party content (if applicable). If you are delivering courses provided by a commercial provider (for example, Skillsoft®), you will need to ensure that the content operates effectively within the LMS you are acquiring. This characteristic is supported through the use of standards and specifications such as SCORM and Common Cartridge (mentioned in 4.15 *Standards support*).
- If the LMS is interoperable with 3rd party content (see above), it offers flexible, secure, and user-friendly payment options such as PayPal®
- Imports course packages of unlimited size (especially important if your eLearning contains rich media, or courses are very long)
- Allows elements of a course to be updated without creating a new version of the course (for instance, swapping out the SCORM manifest file without having to upload an entire replacement course package)
- Presents options to automatically move learners to a new version of a course when a new version of it is created, or allows them to continue on the old version. This has implications for progress data; you do not want learners to lose existing progress data if they are half way through the course. For minor changes to the course, learners should be able to seamlessly experience the updated content with no interruption in their learning flow. However, for major version updates, it can be very hard or inappropriate for an LMS to move users to the updated content while maintaining their progress information.
- Includes a guided course setup feature that walks the administrator through the process of creating a new course, reminding him or her about features he or she might want to add (e.g., discussion forum, blog, etc.)
- Allows creation of custom categories and folders of content, for display to users as well as for internal authoring and management
- Allows assignment of custom thumbnails and icons for content objects displayed in the library or catalog
- Allows course administrators to duplicate or roll course objects/records forward to new sessions without requiring re-entry of data
- Can set activation and expiration dates for content that is time sensitive, or where the license for is only for a certain period
- Features intelligent automated extraction of metadata details (title, etc.) of web-based references and other learning materials added to the LMSs content library
- Has a content organizer feature that allows administrators to easily design and reconfigure a course by dragging and dropping course elements and reordering them
- Allows enforcement of metadata tagging and compliance with metadata standards such that content cannot be uploaded and published without it (especially for end user generated content)

5.6 System access and security

- Uses robust security architecture to maintain system access

- Allows learners to self-register for an LMS account using a unique email address and follow-up email requiring a validation response, to avoid duplicate accounts, incomplete user profiles, etc.
- Has the ability to require at least some fields in the user profile to be mandated to fill out when users initially register or first log on
- Incorporates e-signatures
- Conforms to secure application infrastructure standards such as ISO/IEC 27001
- Allows encryption of sensitive data (i.e., passwords) and session activity (i.e., LMS-related network traffic)
- (for government organizations) Conforms to applicable security regulations such as 21 CFR Part 11, EU GMP Annex 11
- Offers Service Organization Control (SOC) level 2 compliance
- Affords a high level of password security features, for instance:
 - Allows the administrator to require users to use strong passwords
 - Limits the use of old passwords
 - Defines parameters for strong passwords for users
 - Requires users to change the password on first login
 - Locks users out after a certain number of failed login attempts
 - Requires users to change passwords regularly (using notifications)
 - Sets limits on periods of inactivity
 - Only users can change their password
 - Encrypts stored passwords
- Is able to handle digital signatures. In a government installation, this could require compliance with federal regulations like 21 CFR Part 11.
- Provides a single sign-on, so that users who have logged in to the enterprise intranet (through a portal, etc.) can get into the LMS without additional login
- Allows login to the LMS to transfer to other enterprise systems (especially HR)
- Requires user logon only once per LMS session
- Requires each user to be uniquely identifiable (e.g., user name or user ID)
- Runs all user requests through a common security checkpoint in the system architecture
- Was developed by a single company (the vendor), to avoid risks associated with exposure of code to external organizations
- (for high security government organizations) No foreign nationals in the vendor organization (including subcontractor organizations) contributed to the codebase or are involved in hosting (if a vendor-hosted solution).
- Provides audit trails for changes to data in the system such that the organization can quickly determine the source of unauthorized activity that could be the source of security breaches. These changes could include everything from uploading learning objects to running reports.
- Supports industry-standard authentication using such standards as:
 - LDAP

- CAS
- Shibboleth
- Kerberos
- SSO SAML
- Social logins (Facebook, Gmail, etc.)
- (For high-security government installations) Allows Common Access Card (CAC) access
- Incorporates appropriate security certifications and standards, and features (see 4.9 Security considerations for LMSs and 4.13 Special requirements for U.S. DoD). Other security standards you may need include SSL, PKI, and FIPS – 140-1.
- Allows configuration for the management of PII in accordance with enterprise and government policy (such as FERPA)
- (for DoD) Contains multiple security access levels with ready access to unclassified learning material and more stringent security requirements for FOUO and classified information
- (for hosted solutions) The provider:
 - conforms to the ISO 27001 information security management system (ISMS) standard.
 - has Intrusion Detection/Prevention services
 - monitors individual LMS instances for suspicious activity, in real time
 - regularly audits the security of its servers
- (for mobile LMSs. From Towards Maturity, 2014). The LMS includes:
 - Automated renewal of non-compliant devices
 - Remote locking, wiping and revoke credentials
 - Built in encryption – e.g. on device closing
 - Malicious code detection and prevention
 - App management system
 - Standardized administration policies
 - Access control – for example job role-based rules and assign privileges and restriction for handling sensitive data
 - Monitoring of device usage and automating event/incident reporting
 - Secure document distribution (e.g. Secure Content Locker)
 - Support for legacy applications
 - Virus and malware blocking

5.7 Permissions and roles

- Defines a wide variety of permission and role levels that are applicable to a range of organizational structures and use case scenarios for the system
- Restricts course enrollment to pre-authorized learners
- Incorporates permission levels and supporting features that allow input of SME review comments that are tagged to screens, with search and filtering capability. (this is usually only found on an LCMS)
- Uses templates to easily set group permissions

- Restricts access to functions for individual courses based on membership on teams associated with that course
- Allows delegating permissions for users at a lower level of permission than what one is logged in as
- Allows creation of subgroups that inherit permissions of parent groups
- Can be set so learners are anonymous to each other, instructors, and administrators
- Offers “organization aware” features that allow administration based on external data feeds concerning organization roles and permissions
- Allows content-level permissions that specify conditions to be met for learners to be able to view, such as:
 - Payment
 - Added to learner’s “My Learning” track or catalog
- Supports mirroring an organization’s structure in the database to manage learners, supervisors and approvers based on where they exist within the organizational structure
- Features levels of permission corresponding to clearly defined levels of administrative responsibility. For example:
 - Level 1. Overall responsibility for the total system
 - Level 2. Overall responsibility for a specific “store front” instance of the system
 - Level 3. Database Administration
 - Level 4. Maintenance administration of the system. This permission may be segmented to allow users only to perform particular maintenance tasks or for particular user groups.
 - Level 5. Curriculum administration. This permission may be segmented to allow users only to perform particular tasks for certain curricula and/or with certain groups of learner.
 - Level 6. User administration. This permission allows adding and deleting users and setting up groups.
 - Level 7. Content administration. This permission may be segmented to allow users only to perform particular tasks on particular courses. This permission may be subdivided to account for content adding or creation privileges but not content reviewing.
 - Level 8. Authoring capabilities (for LMSs that have this function)
 - Level 9. Learner
- (for VLEs only) Allows instructors or administrators to configure the system to require approvals of users entering a virtual classroom (rather than automatically allowing them to enter upon login).

5.8 System performance

- Performs with minimal latency under a variety of use case scenarios and load conditions
- Handles large numbers of concurrent users
- (for behind-the-firewall solutions) Takes minimal time to actually deploy. As a baseline expectation, Vipond and Clary (2016) found in a survey of corporate LMS managers that nearly one-half (43%) of organizations took more than three months after initial installation to begin enrolling their learners.

- Handles user load efficiently, provisioning and scaling resources to smoothly accommodate fluctuations (especially spikes) in numbers of concurrent users
- Works equally well (all functions, including course delivery) on all standard Internet browsers, including a reasonable span of legacy versions of those browsers (backward compatibility with 2 year-old versions is often used as a rule of thumb)
- Has reasonable system requirements that are attainable within your organization
- Uses normalized architectures for hardware and software implementations
- Can be load balanced across multiple servers, with the LMS application distributed across multiple application servers and the database itself located elsewhere.
- Can be clustered
- Has robust mechanisms for coping with machine failure

5.9 Course catalog database

- Provides a single, integrated or multiple course catalogs whose overall and internal organization can be flexibly defined by a variety of characteristics
- Does not arbitrarily limit the number of levels, items, or sizes of items included in the catalog of courses delivered or imported
- Contains a course catalog including many details of courses, especially:
 - Objectives
 - Credits
 - Course #
 - Cost
 - Associated career track(s)
 - Associated competencies
 - Delivery method
 - Prerequisites
 - Functional area
 - Location (if synchronous)
 - Job skill
 - Product line
 - Subject
 - Associated resources
 - Seat time
 - Keywords
- Has global search function for learners that searches on all of the above plus text within content and allows grouping of search results.
- Offers the following advanced search capability (Foreman, 2013): "...the user can take advantage of the superior search experience to which they have become accustomed with tools like Google, Bing, and Yahoo. Like those tools, enterprise search platforms offer more advanced search methods such as proximity ranking (most to least relevant), controlled vocabulary (synonyms and acronyms), all forms of a word, and spelling correction ("Did you mean...")."

- Can be linked dynamically to external catalogs (for instance, from COTS content providers)
- Provides the ability to organize content into flexible content ontologies and hierarchies, and label them appropriately. For example:
 - Catalog
 - Curriculum
 - Learning Path (possibly tied to a certification)
 - Course
 - Lesson/ Class session
 - Learning object
 - Asset
- Can be updated with release updates and additional courses from external sources
- Provides version control and other management functions for course updates
- Can be configured such that different versions of the course that are treated functionally the same for training administration purposes (for example, the same course delivered in different languages) use the same reference ID in the LMS database. In other words, the LMS tracks and reports that learners have taken the same course, even if there are different language versions.

5.10 Interface customization

- Allows visual branding of the interface for all users in the enterprise
- Allows use of skins to visually brand the LMS dynamically according to the role, organizational membership, or other parameters of the individual user who is logged in. See 4.18 *Instantiation for individual business units*. This can also be important for “extended enterprise” LMs, where branding for different categories of external users (e.g., customers, suppliers, etc.) is important.
- Allows toggling display of the LMS Table of Contents (TOC) for a course, to account for courses with no need for this (for example, courses with just one SCO) vs SCORM courses with many SCOs (and thus a need for good inter-SCO navigation)
- Provides the ability to customize and filter individual tables (vs whole screens) such as lists of courses in progress

5.11 Standards and language support

- Supports the current and all required legacy versions of relevant standards such as SCORM, AICC, IMS Common Cartridge, etc. See 4.15 *Standards support*. For details on what is required for full SCORM support, see www.ADLnet.gov.
- For SCORM content:
 - Is certified at the level of your content, or has been tested for conformance. Do not rely merely on vendor advertisements of their conformance.
 - Retains visibility for the TOC when a SCO has been launched
 - Shows both “attempted” status as well as “completion”
 - Is not overly proprietary in its implementation and handling of SCORM calls other than “attempted” and “completion.”

- Complies with Section 508 requirements for system interfaces
- (For DoD installations) The Standard Data Elements used by the product comply with the DoD Data Architecture (DDA) and Defense Data Dictionary System (DDDS)
- Supports multi-byte (Unicode) fonts (esp. Asian language characters) and right-to-left languages. This requires that the LMS interface text is stored as data, separate from source code.
- Offers flavors of the interface in foreign languages for global reach
- Supports the ADL Training and Learning Architecture (TLA). See 4.15.8 *ADL Total Learning Architecture (TLA)*.

5.12 Training infrastructure and performance analysis

- Includes the ability to enter and capture such items as course development costs
- Provides support for learner surveys and training needs surveys, with options for free text as well as closed ended questions.
- Includes training budget/cost tracking and projecting features that stores and reports (by learner, course, organization, year, etc.) such items as:
 - Budget authorizations
 - Funds allocated
 - Funds still available

5.13 Learning object management

- Allows attaching, associating, and consolidating different content pieces into a single course (for example, core course content delivered as eLearning with auxiliary PDF and video resources included separately)
- Includes ways to link content and assignments in blended learning courses so that it is clear that the components are part of a single course and can be assessed and tracked as such
- Provides a way to centrally manage links so that changes can easily be made to external URLs associated with learning objects.
- Is optimized for reusability in general (not just measured by SCORM support). Some LMSs have their own internal content repository that allows internal mixing and matching of objects in designing a course, curriculum, or learning track.

5.14 Delivery architecture

- Supports a wide variety of delivery architectures. For instance, an eLearning architecture involving a content repository that may be on a different server than the LMS and is supplied by another vendor.
- Can deliver and/or manage as large a variety of learning objects and activities as possible based on such fundamentally different approaches as:
 - Informal learning
 - Constructivist learning environments (problem-centered, discovery-based, game-based, inductive, etc.)
 - Collaborative/social learning

- Blended learning
- Game-based learning
- Can be configured (via proxy server, etc.) to avoid the cross domain scripting issue so that courses not residing in the LMS domain can be launched. This includes launching courses from content repositories in different locations within the corporate intranet, as well as on the Internet.
- Can provide an audit trail for required deployments of mandated training (for example, compliance training)
- Provides integration with social networking services (e.g., Facebook, Twitter)
- Allows delivery of a wide variety of content in different file formats and authoring tools for delivery to learners as either embedded into eLearning modules or separate learning objects
- Has offline player capabilities (see 4.8 *Offline content provisioning and player capability*). Content should look and act the same in both online or offline modes.
- Offers a browse mode whereby testing requirements are suspended (for learners who have already taken the course). This may be handled through content functions or standards like SCORM.
- Allows quick and easy access and launch of short, just-in-time performance support modules. The process of finding and launching these should be easier than normal eLearning since users will often need to launch these while performing a job task; they should not be demotivated to do so by a cumbersome process. These are normally handled differently from regular eLearning courses for this reason, and because they do not normally include assessments.
- Launches courses cleanly and easily, regardless of their source (COTS or Gov't developed, LMS server or other server)
- Includes configuration management and version control features for content. This includes, for example, checking files in and out to prevent accidental overwriting, and revision tracking to audit changes and roll back to earlier versions.
- Supports delivery to mobile devices (see section 3.6 *Mobile learning*), including responsive design approach to the LMS interface.
- Permits bookmarking locations in courses and other content as well as storing commonly accessed screens in the LMS as favorites
- Supports e-commerce charging for content (if the LMS will deliver content on a paid basis to “extended enterprise” customers)
- Includes a user system requirement checker that tests learner systems for appropriate plugins (and versions) before courses are launched. The LMS should not allow you to launch content unless it passes the test.
- Opens a minimum of windows to deliver courses. Some LMSs open chains of 3 or 4 browser windows just to deliver a simple course. If the user inadvertently closes one of these windows, it may cause the course to stop functioning.
- (for VLEs) Allows the instructor to pull whiteboard contents from each breakout room into the main virtual classroom.
- (for VLEs) Allows more than one whiteboard at a time to be displayed.

- (for VLEs) Allows creating learning objects either on the fly during the live virtual session or in stored in advance (and stored persistently within the classroom).
- (for VLEs) Allows more than one instructor to present at once (via talking head videos and screen controls).
- (for VLEs) Allows pausing the video (but not audio) portion of a live session in order to conserve bandwidth.
- (for VLEs) Has the ability to quickly flip back and forth between showing a webcam of the presenter only, show content only, or both simultaneously.
- (for VLEs) Provides APIs that allow embedding of elements (esp. instructor video) into interfaces for other systems (e.g., lms, learning portals)
- (for VLEs) Facilitates storing and delivering recorded videos repurposed from recordings of live virtual classroom sessions, or created as asynchronous content
- (for VLEs) Can easily work with elearning authoring tools, in order to provide content objects that can be delivered asynchronously before or after the live session, or that are designed to be displayed by the instructor during the live VLE session.
- (for VLEs) Allow not just local screen sharing in order to project content, but more bandwidth-friendly server side delivery of content, such as running a PowerPoint file from the server rather than the instructor's computer.
- (for VLEs) Has a robust set of whiteboard tools, to allow the instructor to draw complex diagrams, etc. on the spot.

5.15 Cost

- Costs less for the base application license compared to the cost of other similar systems with similar capabilities and feature sets. This includes all TCO (total cost of ownership) costs.
- Has a licensing agreement that is flexible and easily scalable to reflect changing numbers of learners and administrators. This is especially important if you project substantial growth in your organization, or have “extended enterprise” users (see 7.7 *Extended enterprise learning* for more details)
- Allows you to meter usage of the system by individual business units, so that you can spread the cost fairly
- Costs less for recurring and ongoing support compared to the cost of other similar systems
- Costs less for the database (if included separately) compared to the cost of other similar systems
- Is projected to cost less for required customizations compared to the cost of customizations for other similar systems
- Costs less for add-ons such as APIs to external applications compared to the cost of other similar systems
- Offers hosted (also termed SaaS or cloud) and/or component-based architecture solutions to take advantage of these potentially cost-saving options (see 4.10 *Hosting options* and 7.13 *Component-based architecture* for details)
- Costs minimally extra for separate test, staging, etc. instances of the product (see 4.14 *System environments*)

- Uses or can use open source components (e.g., MySQL) that can significantly reduce costs
- Has a vendor who is open to cost sharing arrangements. If you are planning to make extensive customizations, discuss with the vendor possible partnering on the development and/or cost of such changes so that the cost or development can be shared with the vendor and/or other customers, if other customers who have purchased the vendor's product will receive the new functionality. It is standard practice for vendors to use customer requests for customization as an economic basis for their development of new system features, such that the cost of developing these features (that are included in system upgrades that everyone gets) is effectively funded by these customers.

5.16 Assessment authoring and delivery

- Provides an internal function to create and deliver a wide variety of assessment types (with template options). See 4.16 *Internal assessment authoring* for more details.
- Can export assessments created within the LMS for use in other content or LMSs. Assessments created in the system must be interoperable (using a standard like the SCORM cmi.interactions data element) in order for this to happen.
- Allows authoring and delivery of a variety of assessment item types, including:
 - Multiple choice (both single and multiple answer)
 - Fill in the blank
 - Matching
 - Drag and drop
 - Ranking/ordering
 - Image selection
 - Word scramble
 - Labeling an image
 - Essay or short answer (usually requires instructor intervention to score answers). These should be implemented as online forms/ fields for easy review, not downloadable Word documents.
- Includes a grade book function for instructor-led or blended courses/assignments, with possibility of revising grades
- Allows grades to be assignable to a variety of objects, including discussion and blog postings
- Provides the ability to export and import from Excel or CSV into the grade book
- Provides ability to selectively publish assessments based on parameters such as:
 - Date
 - Time
 - Learner ID
 - Grade book criteria
 - Multiple criteria
- Tracks time it takes for learners to answer questions via time stamps, including time stamps on essay submissions
- Includes display options such as all test questions on a single page vs all on one page

- Can be set to allow navigation back in order to change previous question vs forward only
- Can set up sections in tests which can be hidden from users for easy test management
- Includes management features for group assignments, and apply assignments/topics to multiple groups at once
- Assessments can be set as either summative (for grading purposes) or formative (self-assessments), with different features applied to each (related to when and how the learner can view them)
- Provides a rating or assessment function for mentor/coach/OJT assessments
- Has flexible options for establishing how and when the assessment is delivered (e.g., as a self-check quiz, or end of course test)
- Allows input/upload and management of essay questions, including use of rubrics to grade sets of questions and flexibly apply the rubrics across multiple learning objects, semesters, etc.
- Allows instructors to view and grade essay assignments online without having to download them as files
- Allows embedding of videos, animations, audio, and graphics into assessments
- Can be configured to remediate learners to particular content or locations in content based on assessment results
- Allows importing sets of questions formatted in a standardized format (e.g., QTI)
- Randomizes the order of questions within an assessment and the answers within a question
- Can be set to provide feedback optionally, and after each question is answered vs at the end of the assessment
- Has an interface for setting up rules for determining what happens as a result of learner result on assessment (i.e., failed=forced remediation, another try, etc.)
- Allows creating pools of questions per objective, such that different items can be presented in subsequent learner tries (i.e., learners won't see the same question twice)
- Allows assigning weights to individual answer choices for assessment elements, so that it:
 - Gives learners partial credit for correct answer chosen in an assessment element with multiple correct answers
 - Penalizes learners more for answers that are obviously incorrect
- Allows customizing hints and feedback
- Allows browser lockdown techniques, such as that provided by Respondus Lockdown Browser®
- Incorporates plagiarism detection software
- Allows score display options other than percentage correct (e.g., "9 out of 13 correct")
- Allows weights to be assigned for individual questions so that more important questions contribute more to the learner's score
- Allows use of proctor passwords
- Allows use of enhanced assessment auditing so instructors can see concurrent logins from different IP addresses

- Allows IP restrictions to ensure assessment can only be taken in certain locations (for instance, a computer training facility)
- Allows setting of assessments to either practice or test mode
- Allows export of assessments to Word (for printing)
- Supports accepting informal learning assessments such as learner Web pages and collaborative projects with multimedia, with ability to set and change file size limits for these
- Allows use of math symbols, i.e., equation editor, while authoring assessments
- Supports the ability to tie assessments to learning objectives and outcomes that are input into the system
- Supports the use of learner portfolios for informal learning assessment, either internally or through system integration with a third party product. These portfolios should be viewable after learners have graduated or finished taking an associated course. Portfolios may need standards support, such as Open Source Portfolio Initiative (OSPI) or TaskStream.
- Supports the ability to set conditions (i.e., hide/show, dates) for multiple assessments at the same time
- Assessments created by the LMS assessment authoring tool are Section 508 compliant. This includes the ability to set different time constraints for individuals with disabilities who need more time than other learners.

5.17 Mentoring, coaching, and other developmental scenarios

- Supports infrastructure for managing (assigned on an individual or class basis) of:
 - Mentoring
 - Coaching
 - Groups
 - Projects
 - OJT
 - Shadowing and apprenticing
 - Rotational assignments
 - Career programs
 - Conferences/forums/seminars/workshops

5.18 Collaboration and communication options

- Allows learners to take notes as they interact with learning materials. These notes should be persistent between sessions and automatically associated with locations in the content (possibly with a “sticky note” look and feel). If the learner wishes, their notes can be posted, either internally in the LMS, or publicly outside of the LMS, through APIs to applications like Twitter and Facebook. They should also be able to be exported (as a text file).
- Includes collaboration functions to enable users to communicate with each other, instructors, course administrators, system administrators, etc. These functions typically include the following, and are especially common in VLE software:
 - Email (including group lists)

- Email attachments
- White boarding
- Chat/Instant messenger (IM) (especially for synchronous Q&A sessions in VLEs)
- Blogs
- Microblogs
- File sharing
- Recording of VLE sessions
- Virtual hand-raising (during synchronous VLE learning events)
- Passing presentation rights and application sharing (during synchronous VLE learning events)
- Breakout Rooms (during synchronous VLE learning events)
- Content Annotation
- Ask the Expert exchanges
- Q&A (essentially an open peer help forum)
- Journals
- Threaded discussion (aka forums or discussion boards)
- Desktop sharing
- Community calendar
- Community of practice (CoP)
- Social networking (including as backchannels during VLE learning events)
- Instant messaging
- Learner-created personal web pages
- Dedicated team spaces. Members/teams can be comprised either of learner cohorts taking the same course, or functional teams within the organization.
- Surveys (within and outside of learning events). This includes spot polls of learners during VLE presentations.
- Peer rating of content
- Webcasting, with the ability for learners to initiate sessions among themselves (i.e., not just one-way, instructor to learner webcasting)
- Learner to learner whiteboard (ie, not just instructor to learner)
- Learner posting of web pages
- Learner creation of videos
- For discussion forums and blogs, provides the ability to:
 - Attach documents associated with a posting (learners)
 - Embed links (learners)
 - Allow creation of groups (instructors)
 - Make postings anonymous and/or private that cannot be viewed by anyone higher in the organizational hierarchy (i.e., vertical social network)
 - Search (learners and instructors)
 - Set release conditions (instructors)
 - Moderate (instructors)

- Perform “noise management”, e.g., limiting views of conversations, hide discussion threads (instructors)
- Use rubrics to grade postings (instructors)
- Flexibly configure options to allow and disallow learner actions (instructors). For instance, controlling whether learners will be allowed to create, view, or add to new discussions or threads, or if they are allowed to delete their own comments.
- Provides the ability to send SMS text messages to learners (as either system alerts or actual learning content—note that a considerable amount of higher ed online learning in developing countries is done through SMS)
- Provides robust WYSIWYG formatting options (including direct access to HTML code) for collaboration functions such as blogs
- (for LMSs with VLE capability) Allows instructors and learners to launch virtual classroom/virtual collaboration sessions with screen sharing, video, etc. on the spot when needed.
- If file sharing is provided:
 - Allows learners to include comment tags
 - Allow check-in and check-out version controls
 - Incorporates a user rating system (for relevancy, quality, etc.)
 - Offers a file storage area for each learner
 - Offers direct P2P (peer to peer) sharing options
 - Accepts a variety of file types, such as;
 - PDF
 - Video
 - Web pages
 - MS Office
 - Zip archives
- Provides specific functions that enable learners to provide feedback on the content
- Provides a variety of asynchronous distribution mechanisms for content, including email attachments, RSS feeds, and podcasts
- Integrates with collaborative tools such as Google Apps, Google Drive, and Google Plus so that learners can work collaboratively on projects and attend virtual project meetings.
- Incorporates a recommender system either based on:
 - User ratings
 - Predefined learning paths
 - System inferences based on info in user profiles, performance data, etc.
- Provides summaries of user ratings and other paradata tags, with associated comments
- Provides the ability to display a welcome message upon user login, with info on where to get plug-ins, announcements of new content, etc.
- Provides a means for learners and instructors to easily and quickly annotate learning objects with short videos (especially including videos captured on their mobile device), rather than being required to embed them into the learning objects themselves. This includes short, talking head

elaborations of course elements as it is playing as well as course structure (i.e., within the navigation functions of the LMS).

- Includes online conferencing capability (this is standard for VLEs, but not for LMSs)
- Includes logistical communication functions such as a course calendar and learning assignment pages. Calendars should filter items for relevancy to the role of the person logged in.
- Effectively manages authorization/authentication; manages access to materials and conferences
- Provides social media learning functions that can be integrated into the curriculum to provide social media-based learning assignments.

5.19 Competency management and development/learning plans

(NOTE: these are beyond most LMS capabilities as of this writing. They are included here to guide you as to what advanced features you might want to look for. For information on these features as an emerging trend, see 7.12 *Adding competency analysis tools*).

- Supports competency management and Individual Development Plan (IDP) HR enterprise infrastructures
- Supports competency-based education, showing progress towards competencies
- Automatically links training interventions and competency objects based on user approval
- Features advanced natural language matching algorithms and associated linking functionality
- Allows learners to create and manage e-portfolios
- Maps individuals/groups to a course/curriculum dynamically based on rule sets determined by enterprise requirements
- Operates as a standalone product, so that linking training interventions to competency objects can be performed off-line and then ported to the LMS
- Uses a variety of competency frameworks, providing a range of choices for methods of measuring competencies (for example 360-degree Feedback)
- Uses a variety of competency rating scales
- Includes built-in Update functions to reconcile linkages due to changes in training interventions or competency objects (additions, deletions, or just word changes)
- Imports/exports competency-related data in common database formats such as XML or MS Access
- Can provide IDP progress, training completion, and other related input to competency management, performance appraisal and other HR components of other systems
- Can provide automated analysis/assessment survey of employee's current and anticipated skills and competencies. Gaps are identified with appropriate courses indicated to address closure of gap(s).
- Provides career tracking tools for learners to set and monitor progress towards career objectives
- Prioritizes competencies and courses based on changes in career, regulations, funding, or organizational vision/mission

- Can import competency inventories and rubrics as well as learner data from external systems
- Supports individual development plans (IDPs) with the following options:
 - Dynamic IDP that is updated as employee registers, attends, completes, or does not complete approved training
 - Certification/recertification schedules and notification
 - Competency decay refresher
 - Mandatory/optional training requirements
 - Ad-hoc/emergent training requirements
 - Full reporting capability
 - Compatibility with any competency framework
 - Compatibility with any competency rating scale
 - Performance thresholds (times to complete)

5.20 Learner tracking

- Capable of tracking, reporting and storing a wide range of learner performance data by individual, by group and by cohort groups
- Allows tracking via a flexible, interoperable standard such as the xAPI, and uses a published, industry-accepted controlled vocabulary for xAPI verbs. Note: This requires an internal LRS.
- Contains an electronic training jacket providing a view of career information, including:
 - Training and education
 - Qualifications and certifications
 - Career history
 - Advancement status
 - Awards
- Tracks learner data while learners are taking eLearning in a wide variety of file formats and authoring tools
- (for VLEs) Track “engagement” of users and groups of users (and reports to the instructor via a dynamically updated dashboard) using parameters such as:
 - User participation in chats
 - Number of answers to questions posed by the instructor
 - Interactions with other users within breakout meeting rooms
 - Status updates
- For LMSs that incorporate social media and other features to support informal learning, tracking includes “social monitoring” tools that track:
 - Conversation rate (volume of comments about learning objects)
 - Amplification rate (volume of sharing of learning objects)
 - Applause rate (volume of “likes” posted for learning objects)
- Includes the ability to add custom fields to track additional learner information, so that they can be included in analyses and reports
- Includes RESTful APIs that allow custom views of LMS analytics

- Tracks accredited learning units, for instance, continuing learning units (CLUs), continuing education units (CEUs), and continuing professional education (CPEs)
- (for government installations) Includes the ability to “federalize” data to store SSNs (encrypted), name, CPOID, Activity, Organization, Pay, Occupational Series, Grade and other identifying government information. Note that this information is subject to Personally Identifiable Information (PII) restrictions; the LMS should have security measures in place to protect it. See <http://csrc.nist.gov/publications/nistpubs/800-122/sp800-122.pdf>
- Provides the ability to print a variety of tracking-related items, including test scores
- Can track a wide variety of relevant items, including:
 - Enrollments
 - Withdrawals
 - Launches
 - Completions
 - Attendance (for ILT courses)
 - Competencies acquired
 - Use of materials
 - Evaluations
 - Grades
 - Assessment scores
- Allows a learner to view their own online course results on a lesson-by-lesson basis as well as:
 - Time spent
 - Date and time last accessed
 - Number of test tries
 - Course grade

5.21 Certificates, forms, polls, and surveys

- Allows administrator design/upload and learner delivery of course completion certificates
- Includes electronic signature capability on external form(s), for example, the government SF-182. Signature features for government installations should include SSL, PKI, and encryption for all authorizing levels.
- Allows easy printing of certificates, surveys, and evaluations
- Provides survey functions as follows:
 - Create and edit
 - Import
 - Copy
 - Define properties
 - Preview
 - Define survey link location (for embedding survey in eLearning, website, sending by email, etc.)
- Has different options for design of surveys, such as multiple choice, Likert scale

5.22 Interfaces with external systems and applications

- Includes data migration tools for moving data permanently from a legacy system to the new one
- Interfaces with systems that you might have in your enterprise such as:
 - HR systems
 - HR database
 - Performance management systems
 - Talent management systems
 - Enterprise resource planning (ERP) systems such as such as SAP®
 - Intranets
 - Marketing, sales, CRM, and financial platforms (especially important for “extended enterprise” LMSs)
 - Content repositories
 - Document management systems
 - Learning systems
 - Learner registration system
 - Collaboration tools
 - VLE
 - CrMS
 - LCMS
 - Electronic libraries
 - Third party course content
 - Webinar systems
 - Another LMS or system that you will need to import legacy learner tracking data from
 - IT administrative systems
 - Authentication systems
 - Authorization systems
 - Data validation systems
 - Email directories
- Imports and exports to external systems in real-time and batch mode. This data typically includes not only learner demographics and identification but such things as competencies, certifications, and IDPs (individual development plans).
- Enables add-ons and integration using an open architecture (see 7.5 *Open architectures* for more details)
- Supports use of a third-party database (in compliance with Open Database Compliancy (ODBC) requirements)
- Import and export of learner and course tracking data using standardized data interchange formats (e.g., XML, JSON, CSV) without writing high-LOE integration applications
- Interworks with other systems that manage and deliver training, such that content can be accessed on another system (for example, an LCMS’s content repository). This includes repositories of commercial eLearning courses such as PeopleSoft® and digital reference libraries such as Safari Books Online®

- Has the ability to call external applications and code objects (such as calculators and random number generators), and set up interfaces to read and write from databases
- Is interoperable with a variety of authoring tool(s), including direct import from the authoring tool into the LMS. It is important that you determine which tools your content authors prefer to use and ensure compatibility with those tools.
- Includes “widgets” (add-ons) that allow the learner to access search engines, maps, social media sites, etc.
- Allows student accounts to be securely created, managed and disabled by a connection to an external system of record
- Integrates with Dropbox or other cloud-based file transfer and storage system (to enable easy transfer of learning object and media files from developers to LMS administrator)
- Includes automatic learner registration of new hires based on data that is input to HR system
- Links to employee records in an external system
- Deletes learner ID and training records when employees terminate based on action in the external system

5.23 Metadata support

- Supports the kind of metadata your organization needs or uses (LOM, Dublin Core, etc.). See 4.15.4 *Standards for metadata* for more details.
- Includes a convenient mechanism for adding metadata or descriptive labeling to not only courses, but also to other objects (SCOs, files, activities, etc.)
- Uses metadata to search the course catalog(s)
- Presents options for display of metadata to learners and administrators at relevant nodes in their workflow
- Allows configuring how metadata tags will be input by content developers (checkbox, date, popdown, text box, etc.)

5.24 User profiles

- Has the ability to manage profiles for organizations, not just users
- Has the ability to matrix learner characteristics demographically, organizationally, etc. (for example, assign learners to more than one job role, in more than one organization)
- Can be searched on any field
- Incorporates a recommendation engine that pushes recommendations for learning objects to learners based on attributes of learning the learner has consumed, according to their profile. This could function in much the same way as Amazon.com recommendations.

5.25 Resource management

NOTE: these requirements apply mostly to CrMS products

- Includes features for:
 - Scheduling of operational and training assets

- Weapons practice ranges (DoD)
- Expendables
- Computer learning facilities
- Staff assignments
- Planning training events
- Displays filtered view to learners of relevant items above

5.26 Analytics and reports

- Offers a wide variety and number of predefined reports
- Offers permission levels with different kinds of access to reports.
- Offers flexible, robust abilities to create custom reports, both internally and by using external tools (including those supplied by other vendors such as Crystal Reports®)
- Prints reports easily, with appropriate options
- Provides capabilities to:
 - Administer and maintain performance and evaluation metrics
 - Track individual and group usage statistics
 - Integrate evaluation forms internal and external to the courses
 - Perform statistical analysis on the database information
 - Report on learner performance data by individual and group
 - Easily perform summative evaluations of courses
- Provides direct access to tables used within the LMS for developing queries and reports. This should be documented in table and data structure specifications provided with the product. This is usually a requirement for government installations.
- Provides reporting on certification status of groups and individuals, including upcoming renewals, missed renewal deadlines, etc.
- Provides ways to incorporate data from external systems to produce reports and analytics that show “big picture” measures of employee learning progress activity across all knowledge transfer mechanisms
- (for “extended enterprise” LMSs) Includes ROI analytics-oriented reports
- Provides content-centric reports and/or visualizations that include at a minimum:
 - Average time spent by users in the content
 - First and last access of content
 - Specific sections of content accessed/not accessed, and duration for each visit
 - Number of downloads or user access
 - Number of attempts to pass (on an individual assessment basis)
 - Successful attempts to pass (on an individual assessment basis)
 - Type of content (media file, elearning module, etc.)
 - Expiration or deadline for users to take content
- Provides user-centric reports and/or visualizations that include at a minimum:

- Date items (includes content objects, tracks, etc.) assigned (by admin or instructor)
- Date of start by user
- Date of completion by user
- User score
- Result
- Includes business impact reports for managers that includes at a minimum:
 - Competencies and certifications met by employees
 - Progress of employees towards meeting their IDPs (Individual Learning Plans)
 - Contribution of learning towards meeting business objectives (this may require system integration with ERP systems, or talent management system)
 - Course completions and “not started” courses (especially for mandatory compliance courses)
 - Expired certifications
- Integrated with an xAPI Learning Record Store (LRS) – either embedded as part of the LMS or an ability to communicate with one as an external service.
- Includes analytics engines that include graph charting and visualization options
- Offers features addressing the range of analytics maturity models (NetDimensions, 2015)
 - **Passive reporting** – canned reporting and dashboards
 - **Proactive reporting** – KPI reporting and dashboards
 - **Siloed analytics** – domain-specific relationship analysis
 - **Integrated analytics** – across HR/talent domain and business aligned/ connected
 - **Predictive analytics** – dynamic future scenario modeling
 - **Machine intelligence automation** – dynamic automated data-drive decision making and machine action

5.27 Ease of use for administrators

- Is easy to learn and use, with the ability for users to choose from tiers of features according to the knowledge and expertise of the user. This allows users to start using the program quickly and gradually progress to more complex authoring tiers/feature sets as their skills mature. In other words, users only see features that are relevant to their level of skill and the kind of operations they are capable of performing. Ease of use for administrators is important since it can reduce the skill set requirements and thus the cost of administrators.
- Provides user interface customization (not on the level of tiers of features, as above, but on an individual feature basis), so that both learners and administrators can optimize for their particular needs
- Can easily create and restore archives of system (e.g., transactions), user (e.g., profiles, enrollments), and content data (e.g., courses and curricula) in a proprietary (such as Blackboard Vista .bak) or open format
- Is easy to install and reconfigure
- Manages the administration process efficiently with built-in workflows (for approvals, for instance)

- (for VLEs) Allows assignment of learners to breakout rooms either randomly by the system (evenly distributed) or on an explicit individual basis.
- Administrative interfaces are clear, simple, and optimized for usability. Administrator interfaces are no less important than learner interfaces. Just because learner interfaces are well-designed does not mean the administrative interfaces will be also(!). This is particularly important where there is a need for non-technical staff to perform administrative functions (such as for instructors to pull reports and configure courses).
- Includes options for remote administration from outside the enterprise intranet (through the Internet) and possibly via a handheld device
- Provides features that allow administrators to view role structures in a graphical representation (diagrams, outlines, etc.)
- Provides inline grading tools that allow instructors to grade learners on the same screen as where the assignment appears
- Provides instructors with the ability to access grading tools from their mobile device
- Provides clear, specific error messages that aid in troubleshooting. A generic message that is the same for all errors is not acceptable. You also want to avoid cryptic, technical messages that can only be interpreted by the LMS's software developers. Messages should be understandable not just to technically inclined LMS administrators, but also to content developer s. Also, it is ideal for error messages to vary depending on whether you are in the test vs. the production system.
- Has a feature to store favorite locations within the system
- Allows saving of a workspace

5.28 Ease of use for learners

- Displays interfaces that are consistent and standardized throughout all screens
- Provides a dashboard that indicates to the learner their progress towards meeting their learning goals, as well as common system functions.
- Uses straightforward, simple, and intuitive paths for performing administrator and learner job task functions. You should test your most common and important use cases on the system to verify this. See 8 *Process for choosing an LMS*, step 12.
- Has a feature to store favorite locations within the system
- Where external content (such as Skillsoft courses) is provided and resold, a shopping cart feature allows users to organize and store their purchases.
- (for VLEs only) Allows users to use their telephone rather than VoIP (computer microphone and speakers) to make an audio connection to a session. The telephone numbers provided by the system should be either local or toll free.
- (for VLEs only) Incorporates an option for the system (upon entering a session) to call the user back to initiate the audio connection, rather than requiring the user to call in from their phone and possibly incur long distance charges.

5.29 Transcripts and other documentation

- Allows learners and administrators to print transcripts, course completion certificates, and learner records with appropriate options
- Allows a learner to be able to view a transcript of all training that has been recorded in the LMS for their account along with status and status date
- Incorporates the ability to import and store information about learner badges and for instructors to create them, using a framework such as Mozilla Open Badges. See 7.21 *Digital badges* for more information.

5.30 Scalability

- Has a scalable architecture that allows the system to expand as the number of users increases. The following factors should be taken into account in your planning:
 - Number of concurrent users (current and in the foreseeable future)
 - Database licensing (by seat or site)
 - Database volume restrictions
- Has a scalable architecture, enabling evolution of the client installation without forcing them to go through frequent major version upgrades
- Allows configuration of a data distribution network (interconnect distribution peers through a common distribution server)

5.31 Vendor characteristics

- Has a good reputation among acquisition and system owner communities. Ask the vendor who their other clients are, what they use the system for, and see if you can talk to these clients about their experience using the system. Look for negative comments posted on the Internet by members of these communities.
- Is willing to openly discuss with you changes in the learning landscape, and their roadmap for adapting to these changes.
- Has been in the LMS market for at least 5 years. Avoid the first release of a new system.
- Has not created the product merely as an add-on to an ERP or some other system, in order to be able to sell it to customers desperate to add an LMS to their existing system. Although the cost will probably be lower than purchasing a separate LMS, and the system will obviously be well-integrated with the ERP, it can mean that the LMS receives short shrift in design and usability.
- Has a clear technology roadmap with a reasonable time frame for new versions and additions of new features
- Has consulting experience and arrangements, especially with complex issues such as data migration and change management
- Listens to your concerns during interactions with them, especially during demo sessions of their product. How they are in these situations probably reflects how responsive and attentive they will be to your concerns as a customer.

- Is financially sound and not in danger of going bankrupt. You may want to consider acquiring Dun and Bradstreet reports for your final vendor candidates, to establish the financial health, stability, and long term business strategy of them.
- Is of a stable size, as measured by number of employees, annual revenue, capitalization, etc.
- Has a robust ongoing budget for R&D
- Has a large number of successful clients. Who the clients are and their industry stature can be important, especially in terms of their similarity to your mission or infrastructure. If you can, find out the number of total users served by the LMS product within this client base.
- Is not about to be acquired or merged with another vendor. Obsolescence and durability is an important consideration in the fast-changing landscape of LMSs and enterprise systems in general. You don't want a vendor that gets bought out by another company, and your LMS, with all of your expensive customizations, no longer functions because it has been reengineered to conform to the acquiring vendor's architecture, or worse, has been withdrawn from the marketplace because it is redundant with a product that the acquiring vendor already has in place.
- Has worked with many content developers using a variety of different kinds of content. Ask for references at organizations that have deployed content similar to yours.
- Is familiar with your business model, market, and content types.
- Is International Standards Organization (ISO) and/or Capability Maturity Model Integration (CMMI) certified to ensure high-quality software development output

5.32 User training, technical support, and documentation

- Has robust support for training of all categories of users: learners, instructors, system administrators, content managers, etc.
- Has robust support documentation in a wide variety of forms including tutorials, help, examples, references, and user manuals
- Has a variety of Help Desk support options for administrators and learners (telephone, chat, email, etc.). These need to be in synch with the way your organization normally requests help.
- Offers tiers of support and training (available bundled with the product or purchased separately from it) so that you are not forced to spend more for support than you need
- Has a Help Desk system that is structured and process-driven via trouble call tracking, ticketing, and reporting
- Has Help Desk support that coordinates problem resolution with the appropriate parties: vendors, SME's, etc. for problem resolution
- Has knowledgeable, experienced support personnel
- Is available as close to 24/7 and world-wide as possible
- Offers extensive training options: eLearning, video tutorials, ILT sessions, webinars, etc.
- Has onsite training options. If training is at vendor site, the location(s) are a reasonable distance.
- Includes an orientation tutorial for new users
- Has a low average turn-around time for Help Desk support
- Has a feedback function for suggestions on improving the LMS

- Provides technical consulting services options for customizations, implementation, configuration, architecture design, needs analysis, change management services, etc.

5.33 Media and content support

- Provides support for industry-standard streaming protocols for audio and video
- Minimizes latency in delivering high bandwidth media through robust network throughput and streaming server capacity
- Provides a library function for upload and tracking of user-generated, internal media (especially videos), or provides direct access to web-based media (such as videos on YouTube)
- Provides an enterprise Glossary function
- Has robust support for mobile devices and mobile content, including:
 - Adaptive device detection and delivery according to the size of the device's screen
 - Content provisioning (i.e., while the user is on a free wireless network so they do not incur cellular data download costs)
 - Flexibility in dealing with sudden loss of connectivity
 - Seamless mobility from one device to another (i.e., leaving smartphone and picking up where left off in content on desktop computer)
 - Location-based and context-aware delivery of content
 - Spaced learning
 - Mobile-optimized just-in-time performance support and references (e.g. infobases)
 - Social media tools optimized for mobile use
 - Drill exercises (e.g., electronic flash cards)
 - Mobile collaboration platforms that provide access to experts, mentors, and communities of practice
 - Content management for user-generated content (e.g., photos taken on the mobile device), perhaps via integration with a 3rd party service such as DropBox.
 - (for instructors) Grading
- Has gamification options that can be applied to imported content or content built within the system such as:
 - Points
 - Levels and achievements
 - Badges and trophies
 - Rewards and incentives
 - Game profiles
 - Varied leaderboards
 - Master
 - Group
 - Challenge-based
- Provides support for podcasts and vodcasts
- Supports employee-generated video sharing across the enterprise with the following features:
 - Setting permissions for user groups

- Setting level of user authentication
- Providing security of delivery of the video stream.
- Video streaming to prevent videos from being downloaded into the viewer's computer.
- Supports immersive learning content (simulations, serious games, virtual worlds). See 82 *Support and optimization for virtual immersive environments (VIEs)* for more details.
- (for VLEs) Provides the ability to push screen shots of the facilitator's screen to participants
- Supports interactive video formats with following features:
 - Overlays
 - Assessments
 - Links
 - Chapters
 - Invisible hot spots (popup additional content or annotations)
 - Multiple timelines for different decisions
 - User annotations
 - Social video
 - Comments scroll as video plays
 - Comments can be bookmarked
 - Learner participation in commenting on video fills important content gaps
- Supports a wide variety of media (see below) and media file formats. Examples include:
 - Audio
 - MP3
 - RealAudio
 - WAV
 - AAC/MP4
 - Video
 - MPEG-4
 - RealVideo
 - Quicktime
 - AVI
 - WMV
 - FLV
 - H.264 (high definition)
 - Documents
 - Microsoft Office
 - Adobe PDF
 - HTML5
 - Graphics
 - JPEG
 - PNG
 - GIF
 - SVG
 - 2D animation
 - SWF
 - HLA Simulations
 - HTML5
 - 3D animation

- SWF
- WebGL

6. Popularity of features and capabilities

Roche & Upton (2013) conducted a survey across government and corporate enterprise learning audiences, which resulted in a list of the most popular “must-have features” among those planning to add, change, or replace their current LMS/TMS, as follows:

Course tracking and completion	91%
Web conferencing/virtual classroom	78%
Testing & assessment	76%
Integrated reporting	72%
Mobile authoring and deployment.....	70%
Course marketing and e-mail.....	61%
Virtual learning environments	46%
Survey management.....	46%
Social network tools	46%
Performance management	46%
SaaS or cloud computing	46%
Performance review	41%
Embedded training in applications	37%
Authoring	33%
Collaborative authoring	30%
On-demand option	30%
Succession planning	30%
Mentor/coaching tool.....	28%
Recruitment & hiring management	15%
Compensation management.....	20%
Rapid development	20%

The Brandon Hall Group (2015) reports on the popularity of features as follows:

Ease of use	35%
Ability to adapt.....	26%
Integration with other systems	21%
Personalized content.....	21%
Cost	18%
Robust reporting features	18%
Mobile learning features	18%
Social learning features	12%
Cloud-based deployment.....	12%

Software Advice (2015) reports on the most used features as follows:

Trainee testing	73%
Training administration.....	68%
Record keeping.....	53%
Virtual classroom	45%
Document management.....	45%
Content creation	39%
Advanced reporting	30%
Mobile learning	30%
Social learning.....	27%

eCommerce	10%
Gamification.....	10%

Vipond and Clarey (2016) report that their 2013 LMS survey respondents ranked eLearning delivery and tracking (73%) as the “most important” requirement, followed by reports (69%), search (48%), and version control/historical tracking (48%). Other highly rated 2015 requirements for a future LMS included eLearning delivery and tracking; version control and content tracking; email notifications; search capabilities; and the ability to assign due dates to required training.” (p.5).

7. Emerging trends in LMSs

7.1 Experience API (xAPI) adoption

Currently, most adopters of the xAPI (see 4.15.8 *ADL Total Learning Architecture (TLA)*, including *xAPI* for details) are focused on offering the option of performing SCORM-like functionality using the xAPI instead of SCORM, rather than leveraging the unique features of the xAPI. In order to achieve the latter, vendors will need to profoundly rethink their LMS product model. There are three main dimensions for the kinds of changes for LMS vendors to consider.

One relates to the LMS’s ability to track learning experiences within content other than standard eLearning, such as mobile “learnlets”, simulations, and games. And it needs to track it whether it is launched from the LMS or not.

Second, it needs to track different kinds of data than is possible using SCORM or proprietary LMS tracking capabilities. This includes such things as:

- Attempts, levels achieved, and other milestones rather than simply complete/incomplete or test scores
- Complex learner behaviors that are not part of formal assessments
- Data from learning activities conducted by groups of learners
- Social media and gamification activities, if those are part of the LMS feature set

Third, it needs to track, analyze, and report on a wide range of administrative data other than learner performance, regarding such things as how content is being used (including content outside of the LMS), apparent gaps in topics and areas of knowledge, trends in learner performance, etc.

These three dimensions are particularly apparent in regards to informal learning that does not necessarily originate from the LMS. Up to now, LMSs have controlled the learning space by forcing administrators to predefine and pre-register learning experiences in the LMS. Now, the LMS can routinely receive data (through the xAPI) that it has not been made aware of. This gets inherently tricky in terms of differentiating and giving credit for worthwhile learning experiences as opposed to meaningless ones. It also may need to account for learners (and even systems) it has never encountered before, i.e., that are not pre-registered in the LMS.

One issue in LMS xAPI implementations is the use of controlled vocabularies (for verbs, mainly). This is a complex issue. In general, it is better for an LMS to use a widely published and accepted controlled vocabulary, such as the ADL’s controlled vocabulary (<http://www.adlnet.gov/expapi/index.html>). See <https://docs.google.com/document/d/1Cu6XCoUzd9ExJILTnMCI2Gzx6oeGaC8oSzXzbFHsMjA/edit#heading=h.gjdgxs> for general information on controlled vocabularies.

One of the main hurdles to tracking informal learning is incentivizing learners to manually report their learning experiences outside of the LMS or outside of any content that is instrumented to communicate

xAPI statements. A user-friendly dashboard will only go so far in facilitating this; there needs to be a reason and real incentive structured in the learning environment for learners to take the trouble to report informal learning experiences.

As a business model, this probably means that LMSs need to choose between integrating an LRS and therefore accepting xAPI statements from all quarters of the enterprise, to serve as the authoritative source of all learning records, or remaining as a system serving separate learning management and delivery purposes and publishing learning records to the LRS.

Some industry analysts such as Rustici Software (Rustici, 2014) predict that third party reporting and analysis tools (based on xAPI) will become a large value space for organizations, especially in terms of specialized and niche training systems. LMSs will either need to have their own tools or integrate with specialized independent reporting tools.

For more information on LRSs and how they are being integrated into LMSs, see ADL's white paper titled *Choosing an LRS* (available on the ADL web site at <https://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAnLRS.docx>).

7.2 Support and optimization for virtual immersive environments (VIEs)

There is growing interest in serious games, first person simulations, and virtual worlds. These are often called “virtual immersive environments”, or VIEs (pronounced “vees”). LMSs are now starting to catch up to support these technologies. Most commonly, users want to access the functionality of LMSs and VIEs in one tool, so VIE vendors are also trying to add LMS capabilities into their systems. VIEs integrate LMS functionality in a variety of ways.

The simplest way is for the VIE to offer web browser capability, either inside of the VIE itself or through a daughter window of the application. The learner can then log in to their LMS and take eLearning courses while in the VIE platform.

Another way is for instructors to create assessments or performance-based assessment nodes in the VIE. Learners complete these and, either manually or through an automated script, connect to the LMS (or, at least, the tracking database portion of it) and communicate tracking data. The LMS in this case does not deliver any of the learning; it only provides the performance tracking capability. Usually this requires extensive middleware, though some VIE vendors are working to include connectivity to selected LMSs.

The above cases start with a user who is operating within the VIE platform, who then makes the connection to the LMS. The other way around is also possible, but much less common because it is technically more difficult: launching a VIE as a learning object from within an LMS. The difficulty lies in the fact that most VIEs require a special player, and a VIE server to manage the experience, especially if multiple concurrent users are involved, as in a virtual world.

A proof of concept called Sloodle is an example of this scenario applied to a virtual world. Sloodle integrates the Moodle LMS and the Second Life virtual world by packaging a learning exercise in Second Life into SCORM eLearning using Second Life scripts and Sloodle middleware.

One key stumbling block to the “VIE learning object inside a LMS” scenario is the lack of standards for the middleware and file formats that are needed to be able to import a course containing VIE-based learning objects into an LMS, and have them launched through the LMS. There are attempts currently to be able to author VIE learning objects outside of the VIE platform software. This approach has the potential to be platform-independent.

The other stumbling block is simply the different paradigms of learning that each platform (VIE vs. LMS) is optimized for. For instance, LMSs are designed to afford individual learning experiences, whereas many VIEs (especially virtual worlds) are designed to afford shared learning experiences (potentially with high numbers of participants); LMSs are designed for linear learning paths, whereas VIEs are designed for non-linear learning paths (often determined by many performance parameters based on dynamic events in the VIE). Finally, VIEs vary greatly in their implementations, from single-user structured to massively multi-user open environments. This presents a challenge in defining a universal method for LMSs to integrate with these products.

One logistical requirement for LMSs in supporting VIEs is that concurrent multi-user VIEs require setting up cohorts in advance, for example, work teams that will progress through a game-based exercise together. Automating the assignment of these cohorts (based on business rules, such as homogeneity of job roles) may not be that different than assigning learners to an instructor-led class, but it may be quite different, since it may require some level of configuration of the VIE software (through an API or other communications channel).

LMSs may also need to support a live “learner engagement monitor” who monitors learner scores and progress status in real time and can tweak system parameters for individuals.

For ideas on what may be in store for LMSs and VIEs, visit:

- <http://www.brandonhall.com>
- http://wiki.secondlife.com/wiki/Second_Life_Education/Resources#Blogs
- <http://er.educause.edu/>

7.3 Support and optimization for informal/social/collaborative learning

Collaborative, informal learning is well supported by theory and research (Mayer, 2005), and is often cited as the means by which the vast majority of learning actually takes place in the enterprise. And in the education arena, joint projects with learners at other schools (possibly in other countries) are more and more commonplace, enabled by social media tools. Through this new learning paradigm, learners or trainees can be exposed to a variety of different perspectives, share information, interests, and ideas, and monitor how these have progressed and evolved over the course of a learning project. Informal, social media-based learning is especially well-suited to constructivist learning environments that address higher-order thinking skills.

Users are now demanding social media features as part of the learning toolkit that the LMS provides. These functions can be provided either as applications within the LMS (in other words, created or provided by the LMS vendor), or linked to external public sites. As in the case of VIEs, LMSs incorporate social media functions in a variety of ways. Brandon-Hall (2016) reports that social/collaborative tools are cited as the #1 focus of technology exploration (43% of respondents).

Social media tools support many informal learning approaches (such as coaching, mentoring, and online knowledge sharing), where learners develop and execute their own learning activities or products in collaboration with instructors and fellow learners. Sources of information may not be traditional “authoritative” sources, but sources determined valuable by learners and their peers, and methods of finding them can be based on learner research efforts.

In addition to the two parameters just described (learning based on *authoritative source* vs *user-generated content*), informal learning can be categorized as *informal autonomous learning* and *informal directed learning*.

Informal autonomous learning is learning where the need for learning and the learning goals are determined by the learners themselves. The means for learning, i.e., learning experiences, paths, and strategies, are also up to the learner to choose and/or create themselves. Authoritative source or user-generated learning objects may be chosen by the learner to fulfill informal autonomous learning objectives. This type of learning can and often does take place outside of the workplace, but here we are really referring to learning within a formal performance context (i.e., the workplace), where there is some planning and deliberation involved on the part of the learner to learn something. An example of informal autonomous learning is where a learner unilaterally decides to take an online tutorial to learn how to complete a task he or she has never done before. There is no need for an assessment (and there may not be one available); the learner simply stops when he or she is satisfied that they have learned enough.

Informal directed learning is learning where the need for learning and the goals of it are assigned by an external authority (e.g., supervisor or corporate training department), but the means of meeting the learning goals and objectives is left up to the learner (possibly within a range of predetermined options or suggestions). As with informal autonomous learning, authoritative source or user-generated learning objects may be used by the learner. An example would be where a learner is directed by their supervisor to learn a new procedure through the enterprise learning tools that are at the learner’s disposal (subject matter experts, corporate intranet, references, etc.), with an assessment to be given after the learner is satisfied that they have met the objective, for the benefit of objectively verifying that to the authority who assigned the learning.

Finally, there is a category that is in-between formal learning and informal learning: *non-formal learning*. Non-formal learning takes place where the need for learning and the learning goals are determined by the learner themselves, but the means of learning are controlled by an external authority. Along with this, authoritative source content is required, and assessments are given to ensure conformance to learning and/or performance standards. An example would be where a learner has unilaterally decided to seek a higher-skilled, better paying job position in their organization, takes the HR defined/prescribed learning path of courses (with assessment) to qualify themselves. The following tables show these four paradigms:

Formal

	Need for Learning & Goals	Learning Means	Content generation and access	Assessment
Authority-controlled	x	x	x	x
Learner-controlled				

Non-formal

	Need for Learning & Goals	Learning Means	Content generation and access	Assessment
Authority-controlled		x	x	x
Learner-controlled	x			

Informal Autonomous

	Need for Learning & Goals	Learning Means	Content generation and access	Assessment
Authority-controlled			x	
Learner-controlled	x	x	x	x

Informal Directed

	Need for Learning & Goals	Learning Means	Content generation and access	Assessment
Authority-controlled	x		x	x
Learner-controlled		x	x	

It is important to note that these categories are not conceptually rigid. For instance, in formal and non-formal learning, where the learning means is authority-controlled, the course design might dictate that learners MUST collaborate with other learners (possibly in assigned learning teams), with loose guidelines allowing learner control over many aspects of the learning tasks. This collaboration itself can be an important learning process goal, with technology-enabled assessment of it.

Further, there are design choices for formal and non-formal learning (Masie, 2013), as follows:

- Time Allocation? How much of allocated time is social?
- Learning Processes? Is the social and collaborative learning aimed at:
 - Evidence Models? How are we evaluating the impact of various social styles?
 - Information Transfer - Peers share first level of knowledge directly
 - Contextual - Peers share "back story" of applying knowledge
 - Collaborative - Peers teach and assess each other
 - Remedial - Peers help learners get "unstuck"
 - Assessment - Peers provide testing and assessment
 - Transfer - Peers support applying knowledge at work

LMSs can be designed to support all of these learning and design paradigms, but most LMSs nowadays are still predicated on formal or non-formal learning with individual learners taking prescribed learning paths. LMSs are slowly emerging that allow upload and display of user-generated content, with the ability for users to tag content with ratings, comments, tags, etc. (termed “paradata”). They are also more and more being designed to detect and track user levels of learner collaboration to achieve learning goals, often a design feature of informal directed learning programs. For informal autonomous learning, a well-organized enterprise portal or resource library and a robust search engine can be sufficient for learners to independently pursue their learning goals; there is no particular need for an LMS, especially since learner performance does not need to be tracked.

Currently, most LMSs provide open-ended support for informal learning through simply providing access to social media applications, leaving it up to instructional designers to determine how, why, where, and when those applications are to be used to meet learning goals. These social media applications can either be provided internally and natively within the LMS, but are often provided through established third party applications. These third party applications can be installed behind the enterprise’s firewall and open to use only by employees for business purposes, or available for any use on the Internet.

Social media tools are often only used as a means to deliver content, not to provide activities that support true collaborative social learning. For instance, links to instructional videos are published on community of practice sites, or Twitter is used to remind learners about class assignments—without using the full potential of these tools to facilitate collaboration between learners.

Social media applications to support informal learning include the following:

- Aggregated platforms that offer a combination of most of the items below (for example, SharePoint®, Facebook®)
- Application sharing (for example, Google Docs®)
- Blogs (for example, Blogger®)
- Chat (possibly including webcam) (for example, AOL Instant Messenger®)
- Communities of practice (CoPs) (for example, Ning®)
- Document sharing (for example, DropBox®)
- Expert exchanges (for example, Experts-Exchange.com®)
- Forums (for example, Bloomfire®)
- Idea storming (for example, Stormboard®)
- Micro-blogs (for example, Twitter®)
- Picture sharing (for example, Flickr®)

- Podcasts (for example, iTunes®)
- Social bookmarking (for example, Delicious®)
- Social networking (for example, Facebook®, LinkedIn®)
- Social news (for example, Digg®)
- Video conferencing (for example, Skype®)
- Video sharing (sometimes known as Vodcasts) (for example, YouTube®)
- Wikis (for example, Wikipedia®), often with peer rating of content

These tools are being used to support such informal learning activities as coaching, knowledge sharing, professional networking, on-the-job learning assignments, and other work experiences. But traditionally, LMS products have not been very useful in managing learning that happens in the workplace through these activities.

Shank (2013) reports the following social media tools as technologies used by respondents in their survey. The category names are Shank's; they are slightly different in some cases to those in the above list.

- Videos created by others (YouTube, Vimeo) 46%
- Discussion boards 33%
- Social network (LinkedIn, Facebook) 31%
- Video meetings (Skype, Google+Hangouts) 29%
- Audio created by others (downloadable MP3s) 29%
- Blogs (WordPress, Blogger) 27%
- Microblogging (Twitter) 17%
- Podcasts 24%
- Social network platform (Edmodo, Yammer) 11%
- Community platforms (Ning) 8%
- Social picture sharing (Flickr) 6%
- Social bookmarking (delicious, Diigo) 6.4%

Some LMS vendors are building simple interfaces into their product that provide access to commercial social media functions and sites, with no explicit connection to communities of other learners (i.e., class cohorts), other learning content in the LMS, or performance tracking. However, some vendors are creating explicit connections, whereby the LMS determines, based on performance on an assessment in the LMS, that a learner would benefit from interacting with a community of practice (CoP), members of which might be available to collaborate with and/or mentor them, and automatically enrolls them. There can also be automated features where the LMS would assign subscriptions to social media functions to the learner.

LMSs are starting to emerge (for instance UdutuTeach®) that actually run on social media sites like Facebook, allowing a high degree of integration of LMS and social media functions, representing a movement towards turning social media sites into self-contained learning environments.

Possibly the most important social media feature from the point of view of training stakeholders is the ability of an LMS to create and maintain CoPs. These CoPs can be a cornerstone learning activity within

an informal, collaborative learning design, whereby learners are required to contribute and interact with other learners through discussion forums, blogs, etc. on a CoP. However, automated tracking and assessment of these learner contributions can be difficult. Another popular use of CoPs is to provide a vehicle for learners interested in (or required to engage in) follow up activities to a course, or who are interested in further exploration of the subject matter.

Databases of contactable subject matter experts (sometimes called expert exchanges or expert locators) are important also, either as a separate LMS feature or as a core feature of CoPs associated with an LMS.

Video sharing is emerging quickly as a way for employees to share best practices and knowledge. Research indicates that a typical employee generates almost 3 hours of video per month for sharing purposes, while some organizations estimate that their employees generate more than 20 hours per month (KZO, 2015). See 7.30 *Microlearning* for more information on LMSs designed for video sharing.

The advantage of adding social media to an LMS is simply that it allows the LMS to provide a single access point for all learning experiences, whether centrally managed and formal, or self-managed and informal. This mix of structured vs unstructured learning is quickly gaining acceptance in enterprise learning, and LMSs are stepping up to the plate to accommodate it. No longer are learning experiences defined by a curriculum of structured courses predefined in the LMS course catalog; learners are expected to collaborate and share knowledge through tools and access points provided by the LMS. This sharing of knowledge can be through informal messages posted in blogs, forums, etc., but it can also be through upload of user-generated content such as slides and videos.

This kind of social learning architecture for LMSs often involves adding the following user affordances to be associated with content objects:

- Rating
- Categorization
- Comments (with or without moderation)
- Questions (with or without moderation)
- Contact details for subject matter experts (SMEs)
- Recommendations

Social media as a general learning trend can be seen as a threat to the paradigm of centralization of learning and performance management that LMSs are currently predicated on, with the value placed on authoritative content source and control. However, many LMS vendors are embracing this technology and finding ways to maintain authoritative content source and control over learning despite its seeming pull in the other direction.

Despite the fact that LMS vendors are quickly getting better at integrating social media applications into the delivery of learning (whether maintaining authoritative control over the content source or not), they face a serious challenge in terms of tracking the learning progress of learners within the social media application context. This has led to dire predictions of the demise of LMSs, due to their no longer being able to provide centralized monitoring and reporting of learner progress, one of the core business cases of owning an LMS (see 7.26 *Is the traditional LMS dead?* for more information).

A fundamental problem here is the fact that many social media tools do not in themselves contain any mechanisms for tracking learning; there is no function for an LMS to connect with (in terms of an API) to communicate anything resembling learning progress. Indeed, it would be difficult to define and quantify learning experiences that happen through use of many of these tools. But users are using them for learning (in many cases, in ad hoc, home-grown ways) nevertheless. The ADL xAPI described in 4.15.8 *ADL Total Learning Architecture (TLA)* will have a significant effect on the ability of an LMS to track

informal learning experiences. The xAPI tracks both formal and informal learning via ‘streams’ of learning experiences, similar to social media streams such as Twitter and Facebook.

As self-directed, crowdsourcing-based learning through popular social media tools proliferates among users, organizations will have to embrace this highly decentralized array of tools as legitimate venues for learning. But, as mentioned above, these tools are not designed to interoperate with LMSs, and have no inherent drivers to achieve such interoperability.

A category of system has emerged called “computer-supported collaborative learning (CSCL) environments”. Many are not necessarily LMSs in the true sense, in that they do not afford a way to track learner collaboration and relate it to learning goals. However, with the attention on finding a way to leverage the effectiveness of informal learning for enterprise training, CSCL environments are becoming increasingly instrumented with ways to assess learning. This is not as straightforward as in traditional learning (where multiple choice tests still reign), since it is not just the quantity but quality of communication (both asynchronous and synchronous) that needs to be tracked, where collaboration is either a learning goal itself, or a required means of learning.

The following are examples of ways that learning can be assessed in a CSCL environment (whether designed into the system or through external means). These include both process assessment (i.e., assessing extent of growth in the collaborative learning process) and product assessment (i.e., assessing quality of learner artifacts created using the collaborative learning process).

- Instructor evaluation of growth in subject matter knowledge or skill through transcripts of individual learner postings
- Peer evaluation of the contributions of learners in their learning teams
- E-portfolio evaluation
- Retrospective self-assessment
- Machine grading of essays, concept maps, wiki entries, etc.
- Discourse analysis by instructor to assess learners’ competence in the collaborative process itself

The above address the quality of collaborative communication, which is much more difficult to assess than the quantity of communications (e.g., frequency and length of postings to blogs, etc.). Learning stakeholders are quickly learning that the quantity of collaboration, although a necessary data point, is insufficient alone to truly measure learning.

One of the most important advantages of use of social media in training is that the learner group itself can usually provide a bigger pool of ideas for learning support and scaffolding than the instructional designer can come up with on their own. Scaffolding explanations, visual aids, etc. designed into the course by the instructional designer may work well for the majority of learners. However, allowing learners to see how some of their peers understand and relate to the material (through public postings of some kind) may provide better scaffolding for the statistical outliers who need scaffolding that only other outlier learners who think or learn the same way can think of. These learner postings can also be important where there is insider knowledge or attitudes in the organization or learner demographic group that the instructional designer is not privy to or does not understand completely, and learners can publicly process the material from that insider perspective.

One way that this learner-generated scaffolding principle can be implemented is an internal feature in the LMS whereby learners can take notes and make comments as they are going through the material. These notes and comments can be persistently stored between sessions and automatically associated with locations in the content, and shared with the instructor or other learners. With the multitude of APIs to external social media applications that are now available, this can be implemented such that the notes and comments are posted publicly outside of the LMS, to applications like Twitter and Facebook.

One of the drivers for use of social media in training is project-based, or experiential training. This is typically used in soft skill learning domains such as leadership, where a team of learners is given a project to accomplish and is evaluated on a rubric of parameters related to both process and product. The project may not be purely a learning exercise, but may actually be an attempt to solve an organizational problem. Social media is often leveraged in these cases to facilitate learners accessing the resources they need to complete the project.

In this type of learning, the LMS (mostly through social media applications) needs to be able to push required resources out to learners at planned junctures in the learning experience, as well as enable learners to find and pull ad hoc resources as needed. In this way, the LMS becomes the “command and control center” for the learning experience.

For ideas on what may be in store for LMSs and social media, visit:

- <http://www.brandonhall.com>
- <http://www.elearningguild.com>
- <https://www.td.org/>
- <http://www.gartner.com>
- <http://www.socialmediatoday.com/>
- <http://www.socialmedia.com>

LMSs are now being built around the concept of sharing and collaboration (e.g., ALTO learning portal[®], Spoke[®], Origin Konnect[®], and TREK Learning Experience Manager[®]).

Rather than acquire social media as functionality that is built into the LMS, there are social media software modules that can be integrated into LMSs such as MediaWiki (open source – <http://www.mediawiki.org>).

As mentioned earlier, one of the biggest problems that training stakeholders have with informal learning approaches based on social media tools is that there is no easy, straightforward way to assess and measure the impact of informal learning activities. The ADL xAPI (xAPI) provides the technical capability of tracking of a wide variety of informal learning activities (see 4.15.8 *ADL Total Learning Architecture (TLA)*), but it does not include the interpretive, contextual layer that a system needs to assess the true impact of these activities. LMSs that include competency models and 360-degree assessments are a good start, but a framework is needed to create actionable goals and track progress towards them. Systems such as Momentor[®] (<https://www.envisialearning.com/>) includes goal evaluation tools to measure and evaluate learning gained from informal collaborative learning activities.

If you use an informal social media-based learning paradigm that “mashes up” disparate sites and functions (using your LMS only as the initial launch pad), you may want to consider a single sign-on (SSO) mechanism such as OpenID. This may be especially important if any cloud services outside of the LMS retrieve or post data. OpenID or some other open authentication mechanism can make interconnectivity in the cloud trusted.

7.4 Massive Open Online Course (MOOC) support

A recent emerging trend in social media-based courses are “massive open online courses” (MOOCs). These are courses where both participants and course materials are distributed across the Internet. They are usually based on informal learning principles, relying heavily on social media. Learners participate at the level of their time and interest, and there is no cost. Universities are usually the sponsors of MOOCs. Motivations for universities to sponsor MOOCs include:

- Making courses more openly accessible to a wider audience
- Piloting new courses and trying out new ideas for courses in a low risk environment, where learners are not paying customers (i.e. matriculating learners)
- Showcasing a course in order to identify prospective learners and recruit them to the university

Rather than author and deliver original content, you may be able to leverage content or curriculum components that are already offered in a MOOC. Currently some LMSs that are specifically optimized for MOOCs are emerging. They generally resemble CrMSs (often including VLE components) rather than LMS. For more information on MOOCs, see <http://en.wikipedia.org/wiki/Mooc>.

7.5 Open architectures

“Open architecture” infers that the LMS has APIs that allow integration of external applications and systems into the LMS, including, in some cases, swapping an LMS vendor-provided function with an externally produced one. In some cases, the vendor offers hundreds of APIs that the customer can pick and choose from. Open architectures imply a relaxation of proprietary control and constraints on the part of the LMS vendor, allowing potential users to “look under the hood” at their implementation.

To enable open architecture, the vendor usually must share all or parts of its architecture with add-on/system integration developers. This may require some license agreements between entities sharing the architecture information.

Open architecture products tend to have a service-oriented architecture (SOA), and tend to be designed less as closed systems and more as extensible platforms. Because of this, they tend to encourage innovation and experimentation more.

In spite of the potential for competitive disadvantages resulting from publicly exposing the inner workings of their system, some vendors favor them because their customers want to be able to easily customize the system by purchasing additions that the LMS vendor may not feel are important enough to develop themselves.

Open architectures have driven the creation of a substantial marketplace for third-party applications that can be integrated into the core LMS system as modules. These modules can provide all sorts of functions ranging from anything like adding a calendar function to the learner interface (similar to widgets that you can add to a web portal or cell phone) to providing the capability to share data with an ERP system.

In the future, some third-party add-on applications may be associated only with a particular piece of content, rather than adding a global capability to the LMS. They may customize and maximize the experience of users taking that particular course.

Open architectures could significantly decrease risk in cases where changes to your enterprise learning needs and learning technology in general are expected. In these cases, an open architecture can allow you to prolong the useful life of your LMS by incrementally adding needed functionality rather than having to replace it.

As stated in 4.9 *Security considerations for LMSs*, it is important to find out what programming language and third party OEM components were used to build the product you are considering acquiring. There are innate security considerations for some programming languages, like PHP. Also, if you will need to customize the system, your programming staff need to have the skill sets for that programming language and have licensing access to modify any third party components.

7.6 Adding authoring capabilities

Many LMSs, in their search for new frontiers of functionality to add to their system to add value to customers, have turned to authoring and knowledge management additions. Authoring is a natural addition to many LMSs, since it moves an LMS closer to being an LCMS, accruing many of the advantages that an LCMS affords (except for a content repository) without losing the essential ingredients of an LMS. For more information on LCMSs, see 3.3 *Learning content management systems (LCMSs)*.

7.7 Extended enterprise learning

Enterprises are expanding the learner audience served by their LMS to include partners, distributors, resellers, suppliers, franchisees, and even customers (B2B and B2C), who may be part of the corporate “extended enterprise” or “extranet”. No longer is the LMS relegated only to internal employee training. The learner base and the scope of learning functions are becoming much broader. Learning in this paradigm can include such things as product demos, sales training for retailers, customer surveys, customer support documentation, and more. In some cases, a charge is levied on extranet users. As an extended enterprise learning system, the LMS is becoming more like the enterprise portal, in some cases, becoming completely integrated with or taking over most of the role of the corporate intranet/extranet portal.

In addition to adding extended enterprise features to their standard feature set, some LMSs are actually branding themselves as an “extended enterprise LMS”, and are specifically optimized for customer and partner training rather than employee learning. According to Skilljar (2014), there are 4 differences between a standard LMS and an extended enterprise one:

- Training is more often optional, subject to the needs and whim of the extended enterprise learners, rather than required, as in the case of employees.
- Because of the above, these LMSs rely much more on user experience to attract and retain users. If users do not have a positive experience, they can opt out, whereas internal employees do not usually have a choice.
- Extended enterprise LMS users often pay for training, whether on a per-course or bundled basis, or included in a premium support plan. This relates to the previous point: where external learners are paying for the training, learner experience matters much more.
- Extended enterprise learners are accessing the LMS from a wide variety of locations and IT environments from outside the enterprise firewall. Their configurations and identities are not managed by the enterprise’s HR or IT departments. This complicates user tracking and makes security a much bigger concern.

Here is a sampling some of the features that are important to an extended enterprise LMS (these are included under the appropriate headings in 5. *List of possible requirements for an LMS*):

- Quick system responsiveness
- Ease of self-registration
- Ability to reskin the interface according to different external user groups (especially differentiated from internal user groups)
- E-commerce features for users paying for training
- Data integration with sales, CRM, and financial systems
- Pricing plan that is flexible due to the unpredictability of the number of users and patterns of use

LMSs are now appearing that are targeted specifically for extended enterprise learning, for example, EthosCE®.

7.8 Adding knowledge management architecture and capabilities

Knowledge management (KM) system features seem like they would be a useful addition to an LMS, but functionally it is not that simple, since LMSs deal with content and KM systems deal with information. However, some vendors are trying to bridge this gap.

Expert locator networks are one common knowledge management feature that is either added to LMSs or integrated with it.

An LCMS is a better starting point for integration into a KM system, since that allows you to create small knowledge objects that can be converted and/or combined into training content, and training content that can be repurposed as knowledge objects.

Knowledge management implies robust search capabilities; in this sense, any LMS that provides deep text search of training content is half of the way there to a KM platform.

7.9 Support for team-based learning

“Team-based learning” can mean nothing more than a group of learners in a meeting room taking a course together under one login, presenting themselves to the LMS as if they are one learner and making group decisions about how to complete course activities. It can also mean a group (self-organized or assigned by an instructor) synchronously progressing through a course from different locations and being scored by the average of their individual scores. However, true team-based learning revolves around the idea of learning activities that both affect other team members’ activities and are affected in turn by the actions of others in their team, who may be using a different version or part of the course based on their individual role in the team.

Thus, LMS support for team-based learning involves more than just providing communication functions in the LMS in order to provide collaboration and peer review by multiple learners. Complicated assessment and sequencing paradigms must be enabled, with intelligent agents or middleware automatically tracking and mediating the activities and performance of each team member, and reporting rollup progress to the LMS as well as an audit trail for how these scores were generated (based on individuals’ performance).

As with social media-based learning, team-based learning is especially well-suited to constructivist learning environments. The technological challenges in this type of learning are now being worked out, but there is no universally accepted solution, so no prominent LMS solutions to supporting it have appeared yet. But as soon as the team-based learning paradigm becomes an established part of the training and education space, LMSs will surely move to support it.

You may see more support for team-based learning in LMSs that support the xAPI specification, since the xAPI enables it. The “actor” part of xAPI statements can be an individual or group of individuals.

7.10 “Gadget”- based interface

Gadgets (aka “widgets”, “portlets” or “applets”) are functionalities that are presented as separate items on a page. They are used in many commercial e-mail “MyPage” interfaces, and in many enterprise portal interfaces. They make it possible to completely customize the user interface; gadgets can be turned off so they do not appear on the interface, and can be moved to any location on the page. They can be associated with a specific role so that users only see the ones that are relevant or permitted for their role.

Note: Some make a distinction between “widgets”, which are generic code objects that can be inserted into any web page, like a hit counter, and “gadgets”, which are proprietary and will only work within a particular vendor’s system. Here, we are mostly talking about “gadgets”.

This type of portal-like interface has gained traction with some LMS vendors, simply because users are more comfortable with this type of modern interface, and it allows a high degree of interface tailoring to suit their needs. In some cases, LMSs are being rebranded under the name “learning portal”.

Integrate of the LMS with a portal through gadgets can be achieved in either of the following ways:

- Insert “deep links” in the portal interface (essentially gadgets) to a static location (e.g., a course) in the LMS or use an API to pull data from your LMS dynamically and post it in the portal.
- The reverse of the above: insert links (static or dynamic) to portal locations or objects into the LMS interface

7.11 Adding talent management architecture and capabilities

Talent management systems (TMSs) are sometimes called Integrated Talent Management (ITM) systems. Talent management includes recruitment, performance management, compensation and benefits, succession, retention, career planning, skills gap analysis, career development, and mentoring/coaching administration. These systems mostly deal strictly with these functions and do not provide the day-to-day HR processing functions such as payroll. An *Elearning!* Magazine Group survey (Roche & Upton, 2013) reports that TMSs increased in utilization at 28%, up from 22% in 2012, an increase of 27% year to year.

Talent is the most expensive resource to acquire and maintain in most organizations, so the ROI for TMSs is often attractive, and many enterprises are eager to adopt them. Three popular features sought by those wanting to acquire a TMS are: skills gap analysis, mentoring/coaching administration, and career development.

The terms “human capital management” and “workforce productivity” are also used synonymously with talent management. They overlap with LMSs in terms of the broad scope of their human resource development mission. However, whereas LMSs focus on training of current employees as a solution to a strategic enterprise talent or competency need, talent management systems focus more on recruitment as a solution. Talent management systems are often integrated with applicant tracking systems (ATSs) to manage the recruitment process, and can include performance management, compensation and benefits, succession, retention, and career planning.

Talent management integration or functional merging with LMSs is seen by many HR stakeholders as strategically important to HR functional integration, and for this reason, some LMS vendors are reengineering their LMSs so that they encompass both talent management and learning. This can result in automation efficiencies whereby competencies are assessed and result in recruitment and succession management actions. Career development is of course only one piece of the Human Resource Development (HRD) picture; managers must know who needs to be trained and certified based on what organizational deficiencies exist, and input these deficiencies directly into the process of acquiring new talent, if that is necessary based on the existing pool of talent.

For more information on LMS/TMS integrated systems, see <http://elmezine.epubxp.com/i/74275> (Roche & Upton, 2012, p. 20-23).

McIntosh (2014) reports that talent management system vendors are buying LMSs (for example, SAP purchased Plateau in May, 2011, and rebranded it as SuccessFactors), accelerating the trend of LMS-talent management system consolidation.

7.12 Adding competency analysis tools

Some LMS vendors have demonstrated embedded or standalone competency management or “precision skilling tools” which allow a user to self-assess their competencies in a specific skill area. The most common skill areas where this is being applied are information technology (IT), Microsoft Office applications, and soft skill areas (“leadership skills” or “financial skills”). In lieu of laying out every competency inherent for a particular job or job category, these tools allow a user to analyze them independently and choose courses appropriate to their position, rank, rate, grade, specialty, etc.

Other LMS tools (sometimes called “skill management systems” (SMSs)) are becoming available to training and HR administrators to automate the labor-intensive tasks of manually matching training interventions (courses, units, lessons, topics, OJT, tests, career experiences, etc.) to the organization’s job competency requirements (skills, tasks, knowledge, behaviors, etc.). The competency management process usually includes the following, which is becoming more and more integral to LMSs:

1. Determine competencies required for jobs
2. Profile competencies and their current levels throughout the organization
3. Determine the gap between existing and desired competencies
4. Define objectives and other descriptors of courses that are needed to close the gap
5. Match learner competency deficiencies to learning tracks, training programs, and courses
 - Define user groups based on competency requirements
 - Define courses and curricula based on competency requirements
 - Map competencies to courses or any other training intervention
 - Map learners to courses or any other training intervention
 - Map learners to continuum/advancement tracks
6. Plan learning track and training programs that incorporate these courses, in order to close the gap
7. Provide training recommendations (to include prerequisites) to fill competency gaps
8. Evaluate competencies after learning

7.13 Component-based architecture

In a component-based architecture, a vendor licenses a product for use as an on-demand package of services—customers pay for only the components they use. It presumes a modular architecture whereby the vendor compartmentalizes the system so that users only access (and pay for) the parts that they need at any given time. This method is attractive to many organizations because it can lower costs (since you only pay for the features you use), in contrast to licensing all applications/modules/functionality of the LMS 24/7 throughout the life of the installation, whether you need them or not.

Products with a “service-oriented architecture” (SOA) imply having a component-based architecture, in that services can represent components that can be accessed when needed from the cloud.

Certain aspects of the architecture of such a system must be designed specifically for component-based architecture by the vendor, so that features can be turned on or off, depending on the needs of individual customers. Many current systems offer some degree of component options; qualifying as “component-based” is only a matter of the degree to which the system and the pricing model is optimized for it.

Component-based architectures are usually associated with hosted solutions (see 4.10 *Hosting options*). However, a hosted solution may be sold with or without any compartmentalization. For instance, a hosted solution may simply be a one-size-fits-all system based on a flat fee covering a specific number of licenses that cover using all parts of the system; a component-based architecture solution is usually hosted but in addition also involves a modular, compartmentalized approach, as described above.

Be aware that a vendor may offer a component-based architecture, but only as a possible convenience to allow the customer to reduce the complexity of the system, not reduce cost. In other words, “turning off” components may be possible, but it may not change the cost.

7.14 Multimedia LMS (MLMS)

LMSs are starting to appear that call themselves “multimedia LMSs.” They base their value proposition on the ability to synchronize moving images with still images on two modular screens. One such example is Knoodle (www.knoodle.com). This system is essentially an integrated authoring tool and LMS, since the synchronization is authored in the MLMS (based on imported PowerPoint and video assets). A typical use case for this arrangement might be a talking head video of a senior manager introducing slides introducing a new corporate policy or structure that is shown on the adjacent modular screen.

The principle of a dual panel eLearning module, with video or animation in one panel, and static images in the other, is not new; VLEs can display content in this manner, and many authoring tools allow authoring of this format within the content itself. However, these MLMS products are optimized for this kind of delivery, with the ability of non-technical authors to rapidly and easily synch static images (often in the form of PowerPoint slides) to the video or animation. The content is tightly integrated with the standard LMS functions of learner tracking, tests, surveys, etc. This approach can work well if your organization decides that video synched with slides is the type of content you want to focus on, and you are willing to sacrifice interactivity, since the screens in this type of LMS are usually static. You will also need to have the internal resources to create and edit video.

7.15 Learning Experience Manager

A new kind of LMS has emerged which takes advantage of the xAPI specification’s ability to track learning of all types, including informal and experiential (see 4.15.8 *ADL Total Learning Architecture (TLA)*). It remains to be seen whether the name is accepted as an industry standard for this category of product; it is only offered by one company currently (TREK product - <http://www.cognitiveadvisors.com/>). This product provides an xAPI-required Learning Record Store (LRS) endpoint for xAPI communications, allowing tracking of such learning experiences as:

- Coaching conversations
- Searches
- Video watching
- On-the-job experience

It also allows the awarding of badges (see 7.21 *Digital badges*), learning analytics, ePortfolios, and the creation of individual learning paths.

It remains to be seen whether this concept will take hold in the marketplace. However, it seems likely that it will emerge as a viable replacement or “sideware” option for LMSs, given the growing level of awareness acknowledgement among learning professionals that only 10% of learning in the workplace is actually accomplished through formal learning.

7.16 Video conferencing integration

Recent developments such as greater levels of bandwidth, less expensive dedicated room-based videoconference equipment, and free personal videoconference capabilities on desktop computers have contributed to rapid growth in the use of synchronous videoconferencing in training and education.

Screen sharing (of PowerPoint slides, for instance) and voice over IP (VoIP) are usually associated with video conferencing capability; often this set of capabilities is referred to as “web conferencing”. It is still common for vendors to partner with a web conferencing vendor to offer this capability, although some LMS vendors are adopting their own proprietary technology. Shank (2013) reports that 29% of the respondents in their survey reported using this technology.

There are three types of videoconferencing capabilities:

- **Personal** – designed to allow one user to see and talk to another user. These systems run on personal computers or smartphones, usually as a free peer-to-peer service. They usually are limited to one-to-one (between only two persons) communication, but are beginning to offer one-to-many capabilities (although quality usually degrades in such cases). Skype®, iChat®, and LiveMessenger® and FaceTime® are examples of these systems.
- **Web-based** – these resemble the Personal category described above, except that the video appears in a browser and the service is managed through a central server. Because of the server-managed aspect, there is no loss of quality as more users are added to the conference. Examples are WebEx® and Elluminate Live®. Web-based videoconferencing is often a core feature of VLEs.
- **Room-based dedicated systems** – use dedicated hardware, often semi-permanently installed in meeting rooms. These proprietary systems usually include a codec (usually based on the H.323 standard), camera, microphone, large video monitor, and speaker system, and can be quite sophisticated (and expensive to use). Examples are Polycom®, Tandberg®, and LifeSize®.

Interoperability between these types of systems is increasing. For instance, some of the room-based dedicated systems offer software that allows personal computers (i.e., the “personal” category above) to connect to room-based conferences.

VIEs often resemble web conferencing systems in the “Web-based” category in that they allow “talking head” videos of the instructor, but are different in the respect that VIEs usually do not support student videos (at least, live ones). In this respect, VIEs resemble webinar software more closely.

LMSs cannot generally technically integrate or host sessions in the “Personal” and “Room-based” categories, since these rely on external proprietary services, with particular software and hardware requirements. They can facilitate coordinating videoconferencing sessions as learning activities within a course or curriculum, however. This allows instructional designers to incorporate synchronous videoconferencing (of any of the three categories described above) in their instructional design and mix them with asynchronous learning objects. Examples of use of videoconferencing in these cases might include:

- Lecture, discussion, and Q&A with SMEs and instructors
- Virtual field trips
- Real-time collaboration on assignments between classrooms, assignment working groups, and individual learners, especially in different parts of the world

7.17 Search-based learning

Google has become the default, preferred source of learning for many workers.

What does this mean for LMSs? The LMS must be able to handle federated searches across applications and domains. Searches should include not only the LMS, but the Internet, content repositories, and databases of experts. Being able to store content in a way that is optimal for quick and easy “just-in-time” future retrieval is an important element of this function. This involves not only bookmarking sites, but extracting small chunks of content to be stored in a knowledge management application or database.

A quickly emerging trend in not only search-based learning, but in knowledge management and the Web in general, is latent semantic indexing. This is particularly important for unstructured content, which may not be metadata-tagged, organized within some meaningful context or hierarchy of objects, etc. Systems are getting smarter at extracting meaning and relevance from such content, and not only making it easy for users to find content, but taking it a step further, as Content Analyst Company (2015) coins the term “the content finds you”. Content Analyst Company (2015) reports that knowledge workers spend 16% of their time searching for information, and they find the information they need only 56% of the time. Latent semantic indexing systems offer vast improvements over this, where systems:

- Infer user’s interests
- Adapt to changes in terminology
- Overcome keyword limits

The success of these systems may obviate the need for LMSs in informal user-directed learning scenarios, if relevant content can quickly and reliably be found through searches of content repositories outside of the LMS. If integrated through an API into an LMS, however, these systems could be a very powerful content broker extension to the LMS.

7.18 Content delivery networks (CDNs)

If you deliver high definition video content to a highly geographically dispersed audience, and find that the performance is weak and/or this service is consuming too much of your LMS server resources to maintain sufficient quality, you may want to consider a content delivery network (CDN). Akamai® and Limelight® are examples. These services have strategically placed local servers operating all over the globe that make delivery of high-bandwidth video content smoother to dispersed populations of end users. If you do not have enough video content to justify having a direct, expensive, long-term contract with a CDN provider, there are resellers such as Rackspace (a reseller of Akamai’s CDN) that offer pay-as-you-go agreements. These resellers enable you to deliver just a few videos very cost efficiently.

CDNs are especially important for “extended enterprise” LMSs (see section 91. *Extended enterprise learning*), where the users may be much more geographically dispersed than a self-contained LMS that mainly serves internal employees.

7.19 Integration with digital libraries

Digital libraries (usually mostly reference books, but also containing topical training videos and audios) are an important support for informal learning. Informal learning (somewhat synonymous with “constructivist learning”) puts the enterprise learning function into the role of facilitators and enablers of learning, rather than engineers of learning. Informal learning can be collaborative, based on use of social media to contact peers and subject matter experts, or it can be individually-based, relying mostly on reading and research.

For example, in an individual informal learning scenario, learners might perform any of the following activities, with varying degrees of direction and monitoring from instructors or the training organization:

- Self-tailored reading and research prior to a formal training event
- Enrichment, expansion, extension, and reinforcement reading assignments between or after formal training events that require learners to learn more about what they were taught
- Performance support tools and intranet web search tools that provide on-demand access to references that help them perform unfamiliar tasks in their job
- Learning objects designed into courses that are compiled from online references (possibly dynamically)

Digital libraries are the main enabler of these types of informal learning. There are commercial services such as Safari Books Online® that specialize in offering access to references for these types of learning scenarios. One of the value propositions that these libraries offer is that of maintaining the currency of their works, to support the pace of technological change (these libraries even include pre-publication versions). This value proposition and the authoritative, expert-level source aspect of digital libraries supports the needs of employees and managers for certification, reference, and training.

An offshoot of digital libraries is the organization of enterprise book clubs, which is a good support for both formal and informal learning. Book clubs involve employees in reading new, relevant books and meeting regularly (possibly virtually) to discuss them, often with an assigned facilitator who is either the team lead or a trainer.

Paradata (the ability to rate sources, similar to the rating system in Amazon.com) and built-in search engines are key component of digital libraries, as they can help employees target the most useful information to help them with the task at hand.

Digital library services can be thought of as LMSs of sorts because they often offer LMS-like features such as:

- Reporting and tracking content accessed by learners
- Assigning items to learning plans and competencies
- Maintaining online reading lists for specific courses, employee groups, or individuals

If you already have an LMS, you will want to integrate it with the digital library service and have the LMS present one unified interface for accessing courses, digital library references, and other learning objects. Digital libraries are thus starting to offer out of the box integration with major LMSs.

7.20 Gamification of learning

Recently there has been interest in “gamifying” new or existing learning content, to increase motivation and engagement (through leveraging the natural drive to competition, achievements, etc.). Vipond and Clarey (2016) report in their survey that, when asked if gamification definitely improved learning experience and enhanced knowledge retention, slightly more than one-half (56%) of organizations said they “somewhat agree,” while only 31% “totally agree” with that statement. However, they go on to say that “many organizations did not seem totally convinced about the value of gamification, and nearly one-half believed that gamification is ‘nice to have, but not required’ in a future LMS.” (p. 5)

Kapp (2012, p. 10) defines gamification as: “...using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems.” These elements could be designed into learning content from the start to create a bona fide serious game, or added to a learning experience that is already built. In either case, in order to achieve robust gamification, certain items need

to be implemented in the LMS; the gamification cannot rely on features in the content alone. LMSs are now appearing that do not require content to have any internally-designed game elements; the gamification layer could reside entirely in the LMS and be added solely through LMS configuration.

The LMS needs to support gamification through basic functions such as special delivery mechanisms, security features, enterprise integration tools, and reporting and analytics features, as well as specific features such as interactive leader boards, points/levels/badges, and intangible trophies and tangible real life rewards into the learning experience.

If the content itself is gamified, the explicitly designed levels and points achieved within the content will communicate with the LMS levels and points tracking and reporting capability. For content that is not internally gamified, then the LMS can be configured to have certain achievements or thresholds related to content objects (passing a test in course, for instance) count towards levels and points as tracked and reported by the LMS.

Some LMSs such as OnPoint CellCast® include features such as the following to allow formal content or informal learning experiences to be “gamified”:

- **Standard points** awarded upon achievement of some threshold or triggering event
- **Bonus points** added to standard points for any achievement completed during a time window or duration frame
- **Recognition points** that are discretionary and can be awarded by a manager
- **Earned badges** associated with any defined achievements and attained levels
- **Trophies & rewards** representing different classifications of winners, each with their own unique trophies and rewards
- **Interactive leader boards** that show the results of ongoing competitions between individuals, groups and peers.
- **Assigning points** to any defined learning assignment or interaction
- **Game Profile templates** that can be assigned to any defined group, location, job code or other collection of workers
- **Updating & game analysis features** to support changing an existing Game Profile
- **Test-derived points**
- **Authoring flash card-based games**
- **SCORM-based or xAPI-based scoring**
- **Game results & dashboards** providing real-time results for every defined Game Profile

7.21 Digital badges

The concept of digital badges are becoming popular in higher education and some training settings. It derives its popularity from a new focus on training and educational *results* (credentials, competencies, etc.), rather than *process* (content, instructors, etc.). Digital credentials are seen as a robust and efficient way to express those results, and badges are the primary form these credentials take, allowing them to go far beyond traditional transcripts.

A badge is a file (usually a PNG image file) that contains a record of some learning accomplishment on the part of the owner. A collection of badges is called a “backpack”. Before initiatives like the Mozilla Open Badges Infrastructure, badges did not mean much, since there is no inherent authentication that a

given issuer truly issued it, or that the owner did not create or modify it himself. But initiatives such as the Mozilla Open Badges infrastructure provide a means to maintain a link to the issuer, and can convey the criteria it was issued under, all with built-in verification.

This type of alternative credentialing can be applied at different levels, for instance, showing that a learner has successfully completed an entire course or acquired a high-level skill, as well as micro-level learning elements involved in those. Because they are visible to peers, they enable learners to seek and give help to others whose badge profile indicates that they need it. Badges can be applied very easily in an environment that uses a competency-based model for curriculum and training. Other environments may have to rework their learning environment to accommodate the concept. Badges are currently popular within MOOCs (see 8.3 *Massive Open Online Course (MOOC) support*).

LMSs are starting to incorporate badge infrastructure, i.e., the ability to import and issue learner badges and store badge information in the learner achievement profile, for example, Trek Learning Experience Manager.

NOTE: As of January 2017, the IMS Global Learning Consortium will be taking over the Open Badges specification. The Open Badges spec developed by the Mozilla Foundation is the most popular implementation of digital badges. For more information, see <https://www.imsglobal.org/initiative/enabling-better-digital-credentialing>

7.22 Adaptive learning systems

The word “adaptive” in this context refers to the manner in which a system delivering a learning experience may adapt to an individual learner’s needs, goals, and performance in such a way that the learning experience is better tailored to meet the specific performance problem. In general usage, the term “adaptive system” often describes architectural adaptability, which is the ability to customize an entire educational/training institution’s delivery platform (or combination of platforms) for the particular needs of an organization, e.g., extensibility to support greater numbers of users, ability to change target language, ability to re-skin the interface and add “storefronts”, easily add new components/functionality, etc..

By contrast, what is meant by adaptive system in this context stems from a learning theory/instructional design approach where learning experiences/performance interventions themselves may be “micro-structured” in order to permit the broadest possible opportunity for variation. This capability for variation coupled with a carefully designed analysis engine driving the choice of which variation(s) to deliver to the learner enables a robust adaptive system.

“Adaptive systems” is an umbrella term that includes not only systems that deliver pre-scripted variations in learning paths, responses, screens, etc., but systems such as intelligent tutoring systems that generate new content (some might call these “generative systems”). Whereas, under the pre-scripted variation paradigm, two learners might actually see the same content, there may be little or no chance of that in generative systems, which can create a unique experience for the learner based on what he or she knows, what an expert knows, and the intended outcome.

“Adaptive LMS” is also sometimes used to refer to a content brokering system (see 7.23 *Content brokering systems*) which can overlap with adaptive learning systems. The differentiation between an “adaptive system” and a “content brokering system” is somewhat semantic and arbitrary, but ADL defines it as described in 7.23 *Content brokering systems*: an adaptive system dynamically orders the elements of a learning experience (i.e., content in most cases) *while the learner is already engaged in it*, whereas a content brokering system suggests or prescribes the next prepackaged learning experience (often a course) *after completion of each content object, course, etc.* based on the learner’s history, profile, and either stated or detected needs. A simple way to think of it is that an adaptive system delivers *intra-content* variations to the learning path, and a content brokering system delivers *inter-content*

variations. Also, content brokering systems usually present variations as recommendations that are not simply delivered to the learner as their prescribed learning path, as in the case of adaptive systems.

The simplest form of an adaptive system is an LMS that handles SCORM 2004 sequencing, where, for instance, a pretest determines your learning path through a course, so that you automatically skip parts that the pretest shows you already know. Most adaptive learning systems rely heavily on learner assessment data, as in this example, as the source of information on which to base adaptations. The question is how frequent and detailed are the assessments, how fine-grained are the learning objects, and how dynamic and complex are the learning paths that are delivered as a result of the assessments.

The following is a summary of parameters on which an LMS can base its adaptations:

- Embedded assessments (knowledge checks, quizzes, etc.) measuring their current state of knowledge. In the case of simulation content, assessment could take place during the course of the student's practice performance, without the student being aware of being assessed (this is sometimes called "stealth assessment").
- Past history of the student's learning performance in other content
- Student's own assessment of what they need (such as further reinforcement exercises, etc.)
- The instructor's assessment of what the student needs
- Paradata, i.e., what path is most likely to lead to success for this student based on:
 - Paths that other students took that led to success
 - Student ratings of content or parts of content
- Location, work context, or environment

Another key question in evaluating an adaptive system is: how "intelligent" is the system in determining the current learning/knowledge state of the student and predicting what is the best learning path through the content for them? Is it based on explicit, preprogrammed rules or inferential reasoning (based on AI, cognitive learning science principles, etc.)?

Traditionally, LMSs are more concerned with managing delivery of predefined learning experiences and content rather than dynamically micromanaging the delivery and structure of the learning. That has usually been left up to the content designer. However, with the advent of a more fine-grained and flexible approach to tracking and tailoring learning (through standards like the xAPI), and the ability of systems to assess a much wider palette of the learner's state and context (e.g., see 7.24 *Affective computing*) the adaptations, the LMS is being driven towards incorporating these features. There are a number of LMSs that now purport to be "adaptive".

ADL has developed a rubric for categorizing adaptive behavior in learning systems. It focuses on two questions: 1) At what point in the learning process is the information that determines an adaptation strategy and resulting behavior generated? 2) What is the source of the information that appropriately addresses the resulting adaptation strategy? For #1, there are three possibilities:

- Before the learning experience
- During the learning experience
- After the learning experience (in preparation for further learning experiences)

For #2, there are also three possibilities:

- Learner actions
- Environmental conditions

- Third party actions

For a more detailed version of this rubric, please contact the authors.

7.23 Content brokering systems

Related to adaptive learning systems (see 7.22 *Adaptive learning systems*) are content brokering systems. Both systems result in personalized learning, and the terms are often used interchangeably. But, as described in 7.22, for the sake of clarity in this space, ADL defines a content brokering system as a system that detects a student's imminent content needs based on their performance in an ongoing learning experience, then discovers, recommends, and (usually) delivers the appropriate content to the learner from a potentially wide variety of sources, both public and within an enterprise.

This definition differs from the concept of an adaptive system in the sense that a content brokering system refers to a system that suggests or prescribes the **next prepackaged learning experience** (often a course) based on the learner's history, profile, and either stated or detected needs. As described in 7.22 *Adaptive learning systems*, adaptive systems dynamically order the elements of a learning experience while the learner is already engaged in, or "inside", a prepackaged learning experience, not finished with one and ready to start another (that could be from a different provider or source). In this sense, one could think of content brokering as "*inter-content adaptation*" and an adaptive system as "*intra-content adaptation*".

LCMSs by design achieve a level of content brokering (see 3.3 *Learning content management systems (LCMSs)*). However, they are limited by the fact that the content that they broker must reside in the LCMS's native content repository, thus the content is already known to the system and duly catalogued. That is different from the most robust form of a content brokering system, one that can theoretically search for, discover, and point to and/or deliver any appropriate content, no matter where it is located.

In practice, content brokering systems are often configured to access only certain prescribed content repositories with content objects that the stakeholders prescribe as authoritative source; the difference between this scenario and an LCMS is not only the fact that a content brokering system can access more content than what is in its internal repository, but the flexibility and intelligence it has in discovering and evaluating content objects (for appropriate use by learners) that are not engineered explicitly to be used by it. "Intelligent content" is an enabling characteristic of content, allowing the system (which could be an LMS) to understand more easily who, what, when, where, and how it could best be brokered to learners. For more information on intelligent content, see Berking (2015a).

Content brokering systems, like adaptive learning systems, must have robust assessment capabilities in order to identify learning gaps upon which to base brokering decisions. Systems can use "stealth assessment" techniques to do this, or can base it on formal, explicit formative assessments. A true content brokering system also usually involves more sophisticated methods of determining what content would be appropriate to deliver or recommend next for the learner, up to and including AI algorithms that infer and predict the learner's knowledge needs and preferences.

Content brokering, like micro-level adaptive capabilities, are not fully mature technologies currently, whether standalone systems or part of an LMS. However, with the strong driver of the need for more and more personalized learning, we will probably see robust content brokering systems emerge quickly.

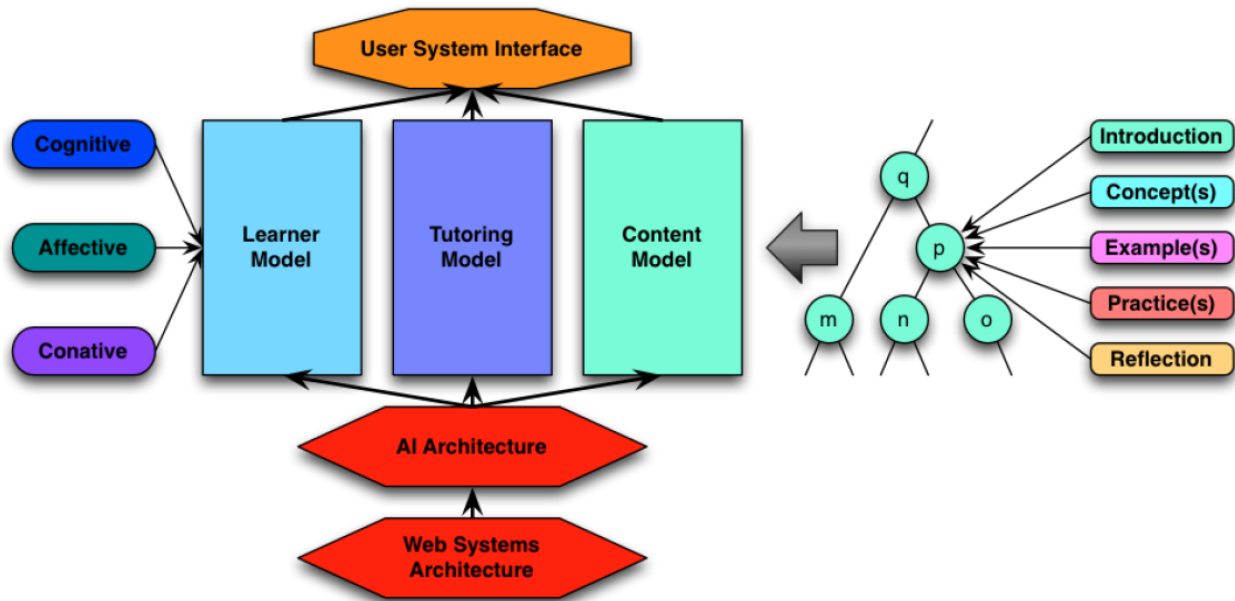
Content brokering is a key functional component of ADL's TLA architecture concept (see 4.15.8 *ADL Total Learning Architecture (TLA), including xAPI*).

A possible starting point for a content brokering system is described by Quinn (2015). Quinn advocates creating and tagging content objects according to the following core elements of a learning experience:

- Introduction
- Concept(s)
- Example(s)

- Practice
- Reflection

These could be manipulated within the content brokering system as follows:



From Quinn (2015), p.17

7.24 Affective computing

Affective computing can be seen as a logical next step in the movement towards adaptive learning. Learner tracking using Big Data, AI-based adaptive algorithms in content, robust learner profiles, paradata, and other features have paved the way towards highly adaptive learning systems. In adaptive systems, learners are presented with or led down optimal learning pathways based on their past learning performance, preferences, cognitive abilities, and demographic characteristics.

The next frontier in adaptive learning is affective computing, allowing a learning application to respond dynamically to the user’s emotions of confusion, anxiety, boredom, etc.. These obviously have a major impact on learning, as any classroom instructor knows and leverages by constantly reading learners’s posture, tone of voice, and facial expressions.

Web cams (that can detect where the eye is focused as well as facial expressions) and voice analysis capability can now detect these items and apply sophisticated analytics in order to optimally adjust the pace and content of the learning. There are many concerns about privacy and accuracy of the detection that need to be resolved before this technology truly goes mainstream, but it is likely that affective computing will be integrated into mainstream elearning sooner than many think. One of the first areas it will be applied is in the high-risk-of-failure professions or job tasks. In these cases, it is critical that learning objectives are fully realized, and affective computing provides a powerful means to ensure that.

Because LMSs are already positioned as the default delivery and tracking function for elearning, they will likely be the focal point for adoption of affective computing for learning. That is, the application that does the detection, tracking, adaptive control of the content will most likely eventually be integrated into the LMS (either natively or as a plug-in application). Stay tuned for further developments in this area.

7.25 Support for performance support tools

The idea of electronic performance support has been around since the early 1990s. It is captured succinctly by the term “just-in-time” learning. That is, performance support is delivered to the learner at the time of need, with minimal interruption in the flow of work. There is usually no explicit intention that users actually retain the information presented in the tool; users just refer to the information in the tool at the point of need and then they can forget about it until the next time they need that information. This paradigm works particularly efficiently for knowledge and skills that users only perform once in a while, and tend to forget between instances requiring them, no matter how much “just-in-case” training they receive.

Performance support seemed to hit a plateau in the 2000s, possibly due to hitting the inherent limits of being only available to workers while they have access to a desktop or laptop computer. This has now changed with the advent of mobile learning; the devices are always with you, and can be used to access performance support not just in just-in-time mode, but just-in-place as well, using location services. Just-for-me (personalized learning) and just-enough (content that is narrowly focused on only what the user needs) learning is following on the heels of just-in-time and just-in-place, often as part of the mobile learning package.

Often, LMSs offer a “browse” mode that allows users to go to any location in eLearning content modules, without being forced to take the assessments by any LMS content sequencing rules. In this way, traditional course material can be used as performance support, though the usability of this depends a lot on the content and system design, i.e., how well the content is topically organized, how focused and self-contained the topics are, search capability, and the detail and clarity of topical menus both on the LMS side and the content side.

But what about performance support that is specifically designed as such? Most LMSs can present content assets (especially media files like videos) as simple objects that are not part of curriculums and course catalogs, in some kind of list or folder structure of objects. However, optimally, these performance support objects ideally need to have a menu system and organization scheme that is organized around the workflow, not the logical structure of the information. This could take the form of a timeline or checklist (with performance support tools embedded into them), rather than a hierarchy of topics.

A key requirement here is for the LMS to provide templates for different types of workflows and generic work structures (such as the aforementioned timeline and checklist) that content authors can populate, so that users can quickly and efficiently navigate to the performance support objects they need. In the future, system integration with detection sensors may evolve, such that the LMS can detect the work context of the user and automatically present the appropriate performance support object. Integration with mobile phone location detection capability is already being achieved as the first step in this direction.

One could argue that a performance support delivery platform is not really a learning management system, since, technically speaking, performance support is not really “learning” (or at least not in the traditional “just in case learning” sense). That is why performance support delivery platforms do not generally call themselves LMSs; instead, they are performance support platforms or just-in-time learning platforms. Examples include WalkMe and Trek.

7.26 Is the traditional LMS dead?

There have been pronouncements from some quarters of the training industry that “the LMS is dead.” On the face of it, this seems like a gross exaggeration; Brandon Hall (2011) reported that 92% of their survey participants do not agree that the LMS is dying. Some industry analysts also have voiced opinions saying the same (Bates, 2012), citing the need for structure, a private place to work online, a one-stop shop for

tools, and tracking data. And as mentioned earlier, Bersin (2014) has reported that the LMS market is well over \$2.5 billion and grew by over 21% in 2014.

However, as a measure of discontent with the current functional capabilities of LMSs, Brown et al (2015) report that, in higher education, "...15% of institutions intend to replace their LMS in the next three years, which is far higher than typical for enterprise-class applications." (p.2). In the training world, Brandon-Hall (2015) report that "...among the 85% of organizations that use a Learning Management System, more than 38% of them are looking to upgrade and replace their current technology." In the same article, Brandon Hall speculates whether this is due to a shift towards organizations making their learning more learner-centric, just-in-time, and focused on performance. How well LMSs can adapt to this shift, and can thus maintain their viability as a central repository of learning functions is not yet clear. In any case, it seems that LMSs are slipping from this value proposition, at least from the point of view of end-users.

The most obvious contributor to this is the growing trend of informal learning, where content can be chosen from publicly available sources by the learner (e.g., found through Google search), learners can have tracked (via xAPI) learning experiences while disconnected to the Internet, and content can be generated and shared by learners through peer networks.

But even with the idea of connected use of authoritative content in formal learning experiences still on the table, the idea of having to log in to a monolithic system (LMS) as a one-stop shop for all learning-related functions and content is disappearing. Learners expect to be able access content whenever and wherever they want. The learning delivery function and learning content objects are becoming more distributed and available across systems, contexts, and devices. On-demand, granular performance support and learning objects are now embedded in a wide variety of application contexts. More and more, these learning objects can be launched anytime, anywhere. For instance:

- A link to a scenario-based learning object within a corporate intranet page that announces a new policy (to train employees on how to handle situations that may come up regarding the policy)
- A link to a compliance training module in an email sent to a mobile phone reminding the user of an approaching deadline for taking this training (which can be taken on the mobile device)
- Screens in a new enterprise system that contain embedded tutorials and performance support

The LMS function needs to operate in the background to communicate with these learning objects and delivery functions and provide consolidated, meaningful measures of learning progress to stakeholders, while being invisible to the learner. They need to fulfill a key role of being coordinators and enforcers of community policy, distributing access privileges, user preferences, content brokering, etc.

In education, the general trend is moving away from course-centric and instructor-centric and towards learner-centric and learning experience-centric, as described in *7.3 Support and optimization for informal/social/collaborative learning*. To keep up with this trend, LMSs need to enable learning more directly through supporting different forms of learning. They will always maintain their utility as a learning administration tool, but to the degree that learners expect the LMS to support the learning itself in its myriad forms, they must adapt to survive. The problem is that administration of learning in many LMSs presumes a standard model of courses; those functions directly influence each other. Building on to the value of the LMS as an administrative tool without being bound to a traditional model of teaching and learning may be too difficult.

The other related trend that is contributing to doomsday scenarios for the traditional LMS is the advent of collections of tools that support self-directed and group-based learning, with great capacity for flexibility and customization. These tools are assembled by individual learners to meet their specific needs, especially for informal learning. The term "personal learning environments" (PLEs) has emerged to describe this trend, which is particularly centered on smartphones and tablets as delivery devices, and

apps on these devices to support ongoing learning needs. The PLE trend has thus driven moving away from centralized, server-based LMS solutions to distributed and portable ones.

Contrary to these doomsday trends, Bates (2012) concluded based on a research study that LMSs are not going away because of the following:

- Most instructors and learners need a centralized online storage area to organize their teaching plans and materials
- Instructors and learners need a private place to work online, outside of publicly accessible social media
- Collaboration and social media tools are not exclusive of an LMS, they can and are being integrated.
- Institutions are becoming increasingly reliant on LMSs for reporting and accountability purposes driven by an increasing need for accountability.

It may be that stakeholders have bought into the enterprise LMS model so firmly that they (perhaps blindly) trust in the ability of LMSs to modernize and add the functionality they need; in other words, they assume that LMS will adapt, as they always have, and effectively address the needs of L&D and availability of modern learning technologies instead of going away. This is implied in a Bersin (2014) research finding that "...61% of companies plan on replacing their learning platforms in the next 18 months, the most frequently cited product to be replaced." Nowadays, stakeholders can get functionality above and beyond the original course delivery platform model of an LMS. As described elsewhere in this document, LMS purchasers can get such new collections of functions as an expert exchange, user generated content repository, and talent management system. There may come a point, however, when bolting features on to a system based on old paradigms will not meet new requirements and opportunities; one of the authors recently heard an LMS vendor at a conference start their pitch with an emphatic statement that their new system was created from scratch to meet these modern requirements and opportunities.

The first step away from a traditional LMS that many organizations are taking is to provide the content delivery function as a service, separately from the LMS, using a browser plug-in or cloud-based application. This enables the "launch anywhere, anytime" paradigm for content. Many LMSs provide an offline player capability (see section 5.6 *Offline player capability*) for disconnected use, but it seems inevitable that they will need to provide this for everyday connected use as well, given the growing "anytime, anywhere" paradigm.

SCORM Cloud[®] made by Rustici Software is an example of an "LMS in the background architecture". It allows you to generate "Dispatch" SCORM packages that you then import into your LMS. When learners run the course from your LMS, it actually bounces them over to SCORM Cloud and plays the copy residing there. Your LMS does all of the tracking as it normally would.

A major challenge in this regard is tracking learner progress. If the content is no longer being launched from within the LMS, how can it find and communicate with the LMS? This problem is being addressed with APIs, standard data elements, and communication protocols, and will require industry agreements on standards.

The role of an LMS in a use case involving an intelligent tutoring system is also currently unclear, although this seems that, given the appropriate back-end channels of communication, an LMS could at least provide value in terms of the tracking and reporting function. A possible start towards this integration is the Generalized Intelligent Framework for Tutoring (GIFT) being developed by the U.S. Army Research Laboratory. See <https://www.gifttutoring.org/projects/gift/wiki/Overview>.

Robson (2009) presents one possible way that LMS functionality may be disaggregated and presented as separate services. The disaggregated services could include the following components:

- Content Orchestration
- Assessment & Evaluation
- Directory Services
- HR Services
- Rights Management
- Search & Discovery
- Competency Management
- Results & Compliance Tracking
- Social Networking
- Content Management

Brown et al (2015) support a vision of disaggregation of the LMS, saying “..although the [Next Generation Digital Learning Environment] might include a traditional LMS as a component, it will not itself be a single application like the current LMS or other enterprise applications.” (p.3). One interesting possibility they mention is that the disaggregated collection of LMS components will become “...a ‘cloud-like space’ to aggregate and connect content and functionality, similar to a smartphone, where users fashion their environments directly with self-selected apps.” (p.3). They also say that the model for the architecture of this confederation of components will be the mash up, enabled by APIs, standards, and reference models. These mashups could be sold by vendors offering a buffet of component possibilities that can be combined into unique blends. These mashups could mix open source and commercial components. One large vendor (Adobe) is in fact predicating their system (Adobe Experience Manager) on an open source core, and basing their business case on selling add-on components.

The term “litigation mitigation system” has been coined to cynically describe LMSs. This refers to the fact that LMSs are used to track employee completion and passing of mandatory courses to ensure corporate compliance with government or corporate policies that require such training (Information Assurance and Sexual Harassment courses are examples). This training removes some of the liability from the company in cases where an employee has behaved negligently, offering the company a defense of “the employee knew better.” This cynical terminology points out probably one of the most enduring use cases for LMSs: delivering assessments and tracking performance on them. The future of LMSs may ultimately hinge on this use case primarily, which may ensure their survival; all signs are that this need is unlikely to go away in the near future (unlike the need to deliver content from a monolithic source).

7.27 Personal Data Lockers (PDLs)

There is rising support for the idea of personal data lockers (also called personal learning lockers, or backpacks) that can follow a learner or employee across different schools, jobs, learning modes, etc. The technology is readily available. All that is needed is widespread acceptance of a universal secure web service, and standards for such, that allow a person to keep their own learning records in the cloud, from whatever sources, and then be able to share them with others.

If PDLs take off in the market, LMSs will be faced with a number of issues to accommodate them, such as whether they will be able to write and receive records from them, managing privacy and data ownership of these records (i.e., matching the level set by the user for their PDL itself), and validating prior learning experiences recorded by the PDL.

The xAPI may accelerate the creation of PDLs, since it provides a way to communicate disparate forms of learning data to a cloud-based web service.

7.28 Web-based client systems

The general trend in many types of software, especially in high security settings, is to minimize the amount of software that needs to be loaded on client machines in order to run applications. “Thin client” or “no client” has been achieved in many types of software, including such computing-intensive applications as VIEs. IT departments also like this because it minimizes their burden of client computer configuration management, version control, etc. It includes not just applications but plugins, drivers, and content. Of course, this puts more reliance on network connectivity, which is not a safe bet for mobile devices. But for desktop computers, it is enabled by the steady improvement in bandwidth and server power and capacity, enabling more of what would normally be handled as client software functions to be handled on the server side, with the client computer effectively acting as a “dumb terminal”.

This trend has already taken hold in LMSs; most of them do not require players or plug-ins. However, some have required a Java Virtual Machine loaded on the client computer and are now advertising “Java-free, web-based clients”. In the case of LMSs written in Java, this is a significant improvement in the sense that the LMS would no longer rely on a Java Virtual Machine being loaded and continually updated on the user’s machine, and no Java applets downloaded (with attendant possible security risks).

Vendors will need to carefully balance performance with this feature, since processing on the client machine is almost always much faster than on the server, depending highly on network bandwidth and server load.

7.29 The Flipped Classroom

A so-called “flipped classroom” is a type of blended learning where learners are presented new content material online (often via video, as in the case of Khan Academy), then do what would traditionally be thought of as “homework” in the classroom. In this classroom phase, learners usually work through practice exercises and examples and can ask questions and get explanations of material presented in the online phase. The classroom is also the place where learners share learning with each other. Class time can leverage the presence of the instructor and other learners to inquire about content learned online and test and reinforce their skills interactively in applying that knowledge. Classroom time does not need to be wasted in lecture and other activities where learners need to simply spend time absorbing the initial new information.

LMSs do not need to have specific features to support flipped classroom other than the ability to deliver normal asynchronous content such as eLearning and video. Additionally, they should support blended learning in terms of associating online content and classroom sessions with the same learning experience or course. It remains yet to be seen if LMSs, or, at least, enterprise ones, emerge that advertise specific support for flipped classroom paradigms, and, if so, what features that would involve other than those mentioned here.

7.30 Microlearning

The concept of microlearning largely emerged with the advent of mLearning. It stems from the fact that short, self-contained pieces of content are better suited for the mobile platform, as opposed to entire courses. Quinn (2011) calls them “learnlets”, and defines them as either microcourses (of just a few minutes in length), featuring a single feature of a product, aspect of a service, or step of a larger procedure; or a five-screen module consisting of: Intro, Concept, Example, Practice with feedback, and Summary. A subset of microlearning is “microlectures”, consisting of short recorded audio or video presentations on a single, tightly defined topic.

The term “microlearning” has particular connotations (for example, Quinn’s as stated above) within the eLearning industry, but “microlearning” can be broadly applied to any learning asset of about 5 minutes

or less duration. It is often associated with blended learning, where mixed-mode microlearning assets can be combined flexibly within a learning experience. These “blended” assets could be a mix of performance support and training modules and well as eLearning and instructor-led training. Short videos (e.g., microlectures) often form the backbone of solutions involving microlearning. Sites such as Khan Academy and TED-Ed specialize in microlectures, which provide particular support for the flipped classroom model (see 7.29 *The Flipped Classroom*).

One of the central tenets of microlearning is that each asset is relatively self-contained, so that the learner can actually complete it in the prescribed short session, rather than accepting an “incomplete” status by leaving a module (albeit perhaps with bookmarking) while it is in progress. It usually does not have strong dependencies on learning from other content.

Microlearning often involves user-generated content, for instance, videos recorded by users on particular topics relating to their work tasks. Video sharing is emerging quickly as a way for employees to share best practices and knowledge. Cavalier (2015) recommends that “micro-videos” be limited to 60 seconds or less, with the following format:

1. Title Bumper (5 seconds)
2. SME/Concept Introduction (10 seconds)
3. Concept/Step 1 (10 seconds)
4. Concept/Step 2 (10 seconds)
5. Concept/Step 3 (10 seconds)
6. Summary/Next Steps (10 Seconds)
7. Closing Bumper (5 Seconds)

The advantages of microlearning are the following:

- Learners, instructors, and administrators have more flexibility to customize learning programs by sequencing small microlearning assets that are each finely tuned to a specific topic or learning objective. Microlearning, especially in the form of microlectures, can be inserted at any point in a sequence of learning activities that constitute a learning program, including after the program begins or after it ends.
- Content brokering and adaptive learning scenarios are easier to implement.
- It is easier for content authors to update the content, since the object generally does not involve large complex files and the impact of changes is self-contained within each file.
- Microlearning doesn’t tend to interfere with work as much (it can be done in small sessions—while waiting for a conference call to begin, for example).
- Microlearning is much more suited to “on the go” mobile learning. Learners can take the learning during otherwise idle moments. It is also quicker to download, which is helpful for mobile delivery.
- It is well adapted to spaced learning scenarios (for more information on spaced learning, see 8.19 *Support for mobile learning*).
- It is consistent with learning science research that posits average attention spans of about 8 seconds in the general population (reported in Makhoulouf, 2015). Given this fact, microlearning can be seen as an effective way “...to allow the learner to experience, absorb, and move on to the next task before losing interest.” (Makhoulouf, 2015).

The implications for LMSs of microlearning are the following:

- There needs to be more focus on flexibly-organized libraries of learning or performance support assets rather than sequences of courses, or curricula.
- Microlearning tends to gravitate the learning environment naturally towards a true performance support environment, where all learning is consumed in “just-in-time” mode. They also move the environment towards a knowledge management environment as well.
- Integration with YouTube, SMS, and Twitter is key, since these are ideal platforms for microlearning. There are also video content management systems like KZO that offer more control and management options over video delivery, with added functionality for end users as well.
- Metadata tagging (and probably paradata as well) is more important, since it allows users to search for relevant content more efficiently and assemble these content objects into complete learning experiences.
- Microlearning is well suited to an LCMS environment, where sequences of assets can be dynamically assembled at run time. In other words, microlearning objects can easily be linked together like Lego blocks.

Video-based LMSs (most of which are predicated on the microlearning concept) are now starting to appear. These are now being called Video Content Management Systems (VCMS). Products include the following:

- Brightcove®
- Kaltura®
- KZO®

These systems feature such things as adaptive bitrate (adjusting the quality of the video to the available bandwidth), search, enhanced security and role-based access, concurrent images (e.g., in PowerPoint) timed to display as the video plays, and synchronous live video lecture/discussion. Some organizations use these systems mainly for storing and delivering recorded videos repurposed from recordings of live virtual classroom sessions. Others use them for videos generated by end users, SMEs, or training staff, specifically to be used as asynchronous content.

One unique feature appearing in some of these systems (KZO in particular) is the ability for end users to overlay comment annotations on the video as they are watching it. These can then be read by other users of the video later, and a discussion forum created around the comments, with users able to click comments and link directly to the pertinent location in the video.

As with any environment involving user-generated content, there needs to be a governance and workflow structure for microlearning videos, to include (Cavalier, 2015):

1. Proper format of the video
2. Metadata and proper tags for video searching
3. Review of video prior to ingestion into the system
4. Voting or likes to make the “cream rise to the top”
5. Empowerment of all subject matter experts
6. Training on how to properly shoot, edit, and post video for employees

LMSs that handle microlearning and microlearning videos need to account for these in their features and design. This is especially important in an environment where you allow “self-service videos”, i.e., users can generate their own videos and post them into the VCMS. Note that metadata tagging in this case

usually requires changes to business policies and procedures (and enforcement mechanisms, such as metadata checks that do not allow publishing of content objects unless the system detects that they have been properly tagged), since it requires extra work that end users will try to avoid if they can.

Microlearning videos can be of various lengths, depending on the limitations of the platform. Here are some examples:

- YouTube® = 10 minutes
- Twitter® = 30 seconds
- Instagram® = 15 seconds

Barry (2016) reports that “According to research conducted by Bersin, most learners won’t watch videos longer than four minutes.” No matter what the platform, this sets a realistic upper limit for microlearning video.

As for much shorter “nanovideos”, it generally does not make sense for videos of 15 seconds or less to have an audio track. To convey the learning message effectively, this makes it even more important for them to be carefully scripted.

Ultra short length microlearning videos often show a process in fast motion, with the ability to click to step through it in normal or slow motion. It is also very important to tag microlearning videos, or microlearning of any kind, with metadata so that individual microlearning content pieces can be assembled into a meaningful whole learning experience.

If you are considering incorporating microlearning videos into your environment, whether you use a VCMS or not, it is very important that you consider the content management aspect, in order to deal with issues such as:

- The difficulty of capturing usage tracking for downloaded videos. A VCMS, by the fact that videos are streamed from it, is positioned to handle detailed usage tracking.
- Rules and permissions for creation and use of videos, especially user-generated videos. Some regulatory environments (like medical, with HIPAA requirements) may have strict rules for details that can be shown in the video, or need-to-know based permissions for viewing them.
- Pushing videos to users (perhaps in a “daily drip”) rather than simply offering them in a “pull”-based library

One value proposition for a VCMS is the ability to easily capture data analytics about learner usage patterns (e.g., at what point did users tend to stop watching? What parts did they rewind and watch over again?). This relies on streaming of videos from a VCMS; download and then local storage and play of videos presents a much more complex challenge to capture data from (xAPI profiles may come in handy for this).

Commercial cloud-based video sites such as YouTube® and Vimeo® can also be used for content management of microlearning videos, usually at no or very low cost. They often offer private channels. Despite this, some enterprises do not want their proprietary material uploaded to a third party site.

One interesting consideration for microlearning videos that can be used to garner support for them from enterprise fiscal managers is the fact that they can be put on the books as corporate assets, in the same way that an entertainment company like Disney considers them corporate assets.

7.31 Data analytics

Wikipedia cites considerable disagreement among experts as to a definition of learning analytics, but uses as a starting point “...the use of intelligent data, learner-produced data, and analysis models to discover

information and social connections for predicting and advising people's learning." (Wikipedia, 2015). It also differentiates educational data mining from learning analytics, saying that the former is not hypothesis-driven, in contrast to the latter.

Whatever academic definition one chooses, the broad, practical aspects of measurement in a learning environment is something that LMSs are starting to pay more attention to. It is not that measurement was not possible or important before, but now the xAPI spec enables you to capture much finer detail of more parameters in an interoperable way. For more information on the xAPI, see 4.15.8 *ADL Total Learning Architecture (TLA), including xAPI*. Through its semantically-based, flexible data model, it facilitates a new level of analysis, by fancy data visualization engines or simple rubberneck checks of data tables, to elegantly answer the perennial questions: Who? What? Why? Where? When? How?

Taking it down a level, here are some examples of the questions that can be answered using a combination of xAPI for data capture and some kind of analytics engine for information output:

1. How well am I doing in this learning experience? (individual learners)
2. Which learners require or are going to require extra support and attention, and in what specific areas? (instructors)
3. What design features of learning experiences are most effective in producing learning in a particular context? (designers)
4. What are the most cost-efficient learning interventions? (stakeholders)
5. How are particular learning resources actually being used? (content authors and managers)
6. What are the best logistical arrangements for marketing and delivering the course? (administrators)

No longer do learning professionals need to be limited to the canned reports produced by LMSs. Traditional LMS reports have served many well for a long time, but we are now in the era of data-driven decision making in the learning space. Data-driven decision-making requires breaking open the black box of data capture and reporting functions within LMSs to provide a much wider range and depth of information than can be provided with predefined reports. The xAPI is also the on ramp towards separating analytics from course delivery and management functions, which is important given that more and more content is launched and/or experienced outside of the LMS.

There is some question of how the LMS fits into this xAPI-driven data analytics picture, since the xAPI does not require an LMS (it requires a web service called a Learning Record Store (LRS)). However, some solutions are starting to emerge whereby the LMS retains its centrality as the repository of learning and learner-related data and records, by embedding an LRS function or by communicating with an LRS service. It remains to be seen whether robust data analytics capability (which would include not only xAPI capability but a data analytics engine) will become part of the design of LMSs, or will be a separate system.

With the resurgence of performance support (in many cases, replacing training), there is a greater need for custom data capture and analytics solutions, solutions that are difficult for LMS to manage. One simple reason for this difficulty is that performance support is by definition devoid of assessments, which are the primary vehicle for measurement for content in an LMS. Performance support tools require data on whether and how they are being used (called "paradata"), not how much learners have learned from them. Paradata for both performance support and instructional content may include a range of individual or aggregate user interactions such as viewing, downloading, time/place/situational context of use, sharing with others, rating, and using content for derivative products. Silvers & Torrance (2015), propose the following categories generally related to paradata:

- Sentiment analysis - What do the words people use tell us about their disposition to learn?

- Engagement analysis - What's the activity level with learning content?
- Cohort analysis - Who forms what groups for what reasons?
- Keyword analysis - How do people seek info & what do they find?
- Conversion Rate - How many people respond (i.e., comment)?
- Amplification Rate - How many times is something shared?
- Applause Rate - How many likes/favorites/bookmarks?
- Economic Value - Short/Long Term Revenue/Cost Savings?

The xAPI is especially useful for performance support given that work behavior, output, and productivity can be conveniently measured with it as well. In other words, you can use the xAPI to instrument the work environment in addition to the learning environment, and the integration of these analytics can be very powerful in creating feedback loops to fine tune your learning interventions (as well as business processes). Kirkpatrick Level 3 and above evaluations can be more easily institutionalized within your learning environment in this way.

The xAPI can not only bridge work and learning data, but it can bridge a learner's physical state over time with learning activities or work performance so that, for instance, heart rate can be correlated with work or learning tasks to determine points of high stress.

Data visualization that allows recognizing complex patterns and trends is an important capability enabled by the xAPI. Because the xAPI allows precise, microscopic statements describing a learner or system's state at a specific point in time, trends can be seen easily with graphs, diagrams, etc. You do not need to create expensive custom visualization engines to do this. Open source solutions are available such as ADL's xAPI Dashboard (<https://github.com/adlnet/xAPI-Dashboard>) and Apereo Open Dashboard (<https://github.com/Apereo-Learning-Analytics-Initiative/OpenDashboard>)

The obvious, traditional approach to analytics is to plan your analytics solution (using xAPI in this case) to answer specific questions first, then capture data. This works where you have specific measurement needs that are already clearly defined, usually resembling the typical reports provided by LMSs. For those inclined towards thinking of data analytics more as research and data mining (ie, without an initial hypothesis, as mentioned above), the xAPI provides a durable, interoperable basis for analytics engines to create visualizations that can reveal unexpected patterns. One can think of this approach as "measure first, ask questions later" - in other words, capture lots of different kinds of data just because you can, and then explore to see what emerges from it from analysis. The steps for this kind of research-oriented approach could be:

1. (optional) Formulate baseline research questions. You need some idea of these, even if you are using this exploratory approach, as a basis for Step 2 below and data analysis/visualization methods later.
2. Decide what interaction nodes and learner behaviors in the learning experience make sense to instrument with xAPI.
3. Decide what granularity you need and the right syntax and verbs for your xAPI statements. This is essentially becomes your hypothesis, if you are using one.
4. Deploy xAPI-instrumented learning experience and collect data.
5. Validate data received against research questions
AND/OR
Look for patterns
6. Refine xAPI granularity, verbs, LRS queries, etc.

For those inclined towards data modeling and “what if” scenarios, not only can historical data be collected and subjected to various analyses after the fact, but specific hypothetical data (ie, xAPI statements) can be substituted for real historical xAPI statements. The xAPI allows you to insert these hypothetical statements in a surgically precise way and then play out the scenario in your data analytics engine, to see what results could emerge that are different from the real results.

8. Process for choosing an LMS

ADL recommends the following high-level process for choosing an LMS.

1. Hold stakeholder meetings to **determine the basic feasibility of an LMS acquisition, and how your organizational goals can be met with it**. You need to answer such questions as: What business problems do you hope to solve with it? What are the risks? What resources will it require? What new processes and business rules will it require? What data will it collect? All of this needs to be looked at under the lens of feasibility. For instance, if new processes and business rules are required, who will create and enforce them? If you are going towards a competency-based HR environment, who will create and maintain the competency data, and who will verify mastery of competencies? In these meetings, be sure to include all cross-functional stakeholders for whom implementing the LMS will have direct or indirect (especially financial) consequences. This includes HR, T&D (Training and Development), CEO and senior leadership, and IT staff.
2. With stakeholders, **decide on a process and timeline** (preferably with a formal project plan) for how the LMS acquisition project will proceed, using the high-level steps outlined here, or some other process.
3. **Determine the high-level requirements** for your LMS, in each LMS functional area described in 2.1 *What is an LMS?* Ensure that you get input from all groups of potential users, not just stakeholders, and solicit input from your HR and IT departments. It is important to stick to only the critical, high-level, and highly differentiating requirements at this point. That will serve to quickly filter many unsuitable candidates when you get to step 7 below. This may require a formal requirements definition effort, especially if you are a large enterprise with many different groups of potential users who may have different (and hard to predict) needs.

Be aware that there are many types of requirements (functional, usability, etc.), representing different points of view (users, administrators, stakeholders, etc.). See Wiegner's (2000) article at <http://processimpact.com/articles/reqtraps.html> for information on how to avoid “requirements traps” such as ambiguous or vague definitions.

If you have never used an LMS before, you may want to consider gaining a year of experience with a simple, inexpensive or homegrown system before you buy a major enterprise system. This could help clarify your goals and requirements substantially.

Some important general considerations that may impact your list of high-level requirements at this point include:

- Whether you will need support for compliance training. This will require robust tracking features and probably certain kinds of reports.
- Whether you need to deliver commercial off-the-shelf (COTS) content, as opposed to content you develop yourself. In the former case, you will need to ensure that the COTS content will run successfully in the LMS.
- Whether you will need your LMS to focus broadly on HR and Talent Development issues rather than strictly on traditional training.

- Whether you want an “all in one” system that contains everything you need, or whether you already have some LMS software functions or components in place that you do not need included in the LMS. Even if you do not have these functions already, you may be planning to accumulate them gradually outside of the LMS you purchase.
4. **Determine your budget** for purchasing the system and associated support/training contracts, as well as any customization you need that you predict that the system will not provide out of the box. Your budget should ideally be not simply based on available funds, but a cost-benefit analysis of implementing the system; at the very least, the cost of the system should not exceed the true cost of not solving the training problems that you would be counting on the LMS to solve. Assigning dollar values to employee training problems is notoriously difficult, but when acquiring a large expensive system, a formal cost-benefit analysis may be worth it. (See 4.4 *Pricing models* for more information about pricing.). You may want to explore cost sharing opportunities between your organization and others that may benefit from the system.
 5. **Determine the category of system you will need** (see 3 *Categories of systems to deliver and manage learning*) and types of learning you need to deliver (see 2.4 *Types of general learning goals managed by LMSs*). If there are only certain major capabilities that you really need, you may be able to save money by buying only the components or services you need. If you already have a CrMS, for instance, you want to consider acquiring or developing just the course delivery module, or vice versa, instead of an entire LMS.
 6. **Identify specific systems** that match the category and support the types of learning you identified in step 5. Because these categories overlap, you may identify more than one category for consideration. You may decide at this point to develop your own product rather than purchase a COTS LMS. Note that if you are a U.S. government entity, the government acquisition process requires justifications for acquisition choices. You will need to validate or justify your decision to develop your own system (vs buy a COTS product).
 7. **Develop and populate a system requirements matrix** that allows assessing the systems identified in step 6 against your requirements developed in step 3. See the *Appendix A Sample System Requirements Matrix* for a sample. If you are considering more than one category of system, you may want to complete a separate matrix for each different category of system you have identified as a requirement for your organization, since each category of system has its own distinct parameters and typical feature sets. After completing the separate matrices, you will then need to decide which category you will pursue, if you are intent on or limited to purchasing only one system.
 8. **Filter the list of potential candidates**, eliminating those that do not meet your minimum requirements and/or are over your budget. It is important to focus on your core needs - use weighting in the provided selection matrix (see *Appendix A: Sample System Requirements Matrix*) to establish the absolute vs “nice to have” requirements.
 9. **Create and send your list of requirements to remaining candidates.** This includes requests for information (RFIs) or requests for proposals (RFPs) if necessary—whatever formal documentation is required for your acquisition process. Templates for these documents are usually prescribed within corporate or government organizations. If not, you can find templates on learning technology consulting firm web sites, LMS vendor web sites, or by searching on the Web. Note that some small LMS vendors may consider lengthy, detailed RFPs onerous to respond to, thus may decline to respond.

Altieri (2016) recommends the following when writing requirements lists for vendors:

- Add one bogus, nonsensical requirement to any list of requirements sent to vendors, as a check against whether the vendors actually read the list. If they say that they can meet all of the requirements, or do not ask about that requirement, they can be ruled out.
 - Don't mention your current system (i.e., what it cannot do that you need in a new system)
 - State requirements in the positive, not negative.
 - Avoid jargon and acronyms or provide a glossary.
 - Consider what your needs will be at the time the system will actually be deployed, not what they are now. Remember that implementations often take a full year from actual acquisition. Requirements may change during this time on a range of issues, from capacity of concurrent users to types of learning supported.
 - Plan to have your LMS for 5 years—that is a typical “useful life” duration for an LMS, due to changes in learning technology space that may make it obsolete.
10. **Compile a detailed, comprehensive features list** for all of the remaining candidate systems. You may want to start this list by sampling the features of one system that seems to be the most feature-rich, and add any features uncovered by your analysis of other systems as you complete the comparison process. Or, you can use some or all of the requirements mentioned in *5 List of possible requirements for an LMS* as your features list. You may want to edit this list of features to only those that you care about now; however, this may be limiting since you may be unfamiliar with the usefulness of some features, or they may become useful sometime in the future.
11. **Develop a system features rating matrix** (see the *Appendix B: Sample System Features Rating Matrix* for a sample) that compares the systems filtered in step 8 using the features list developed in step 9. Complete as much of this matrix as possible from the systems' documentation; if you need more information, ask their sales representatives for it (though beware of overblown claims—verify lofty ones independently if possible). Follow the instructions in the supplied matrix in the Appendix to assign a numerical rating for each cell in the matrix, indicating degree of implementation of that feature, and assign a weighting score to weight each feature according to its importance to you, enabling a rollup score for each system. This scoring regime should ensure that an abundance of only nice to have features does not overshadow the lesser number of core features you must have.
12. Contact the top scoring vendors (three to five is a reasonable number) from the previous step and **ask for a presentation/demo**. Ask the vendor for a demonstration in your facility, running your content on their system. The vendor may want to present a canned demo of their product using PowerPoint or Flash, and that is fine as a general overview of the system's capabilities, but you should see how well the system expresses these capabilities within your IT environment using real content. You might also want to ask vendors to provide a list of three customers who would be willing to host site visits or talk to you *without* the vendor present. Some experiences you might want to ask these customers about are:
- Contract negotiations
 - Customizations and turning on/off baseline features
 - Implementation process
 - Responsiveness and quality of support

You can also investigate blogs, reviews (often offered on professional organization sites) and other online resources to assess the quality of the vendor.

It is recommended that you consider creating use case scripts (scenarios that will demonstrate the system's ability to meet your specific needs), representing common, mission-critical tasks that an LMS user would perform. During their demonstration, the vendor performs the steps required to fulfill each use case. This is a good way to evaluate how effectively and smoothly the system maps into your use cases. You can also request that the vendor set up a sandbox for hands-on testing with the system by your administrators, instructors, and learners. LMS acquisitions are usually expensive, so it is not unreasonable to ask for this. See 4.20 *The path of least resistance* for an important caveat in evaluating features.

It is important to establish a firm, contractually-binding baseline of what you would be buying “out of the box” vs what would require customization above and beyond that baseline. Some vendors may blithely tell you that their system can meet certain requirements of yours, but what it really means is that the system has an architecture that allows integration of those features with some amount of customization, which is an additional charge. You should clarify with the vendor what constitutes “customization” (ie, requires actual programming) vs “configuration” (ie, changes that can be made by the system administrator without any programming and system integration).

You may be able to negotiate using the product free for a limited trial period. This can be very valuable for gathering user feedback and getting an idea of what the vendor relationship will be like.

13. **Augment the matrix** with the additional information gained from step 11, adding any impressions and notes from the vendor demos.
14. **Make your decision** based on feature comparison (including the weighting you have assigned for each feature) and experiences from the demo sessions, taking into account TCO (total cost of ownership), including the application, training, “software assurance” (yearly cost that includes upgrades, version releases, etc.), maintenance, hardware that you will need to run it on, etc.), customer support, and any intangibles. Total Cost of Ownership (TCO) is usually a 5-7 year window for LMSs. As enterprise systems usually require a minimum server architecture and LAN support, another consideration is whether a hosted solution (see 4.10 *Hosting options*) or component-based architecture solution (see 7.13 *Component-based architecture*) may be right for you, if one is available from the vendor. Get someone (who may not be in your learning organization) who has negotiation skills and experience involved to negotiate such important terms as pricing and licensing.

Holloway and Armstrong (2015) describe a similar process to the above.

Other processes for selecting LMS or other large systems that rely more heavily on demonstrations of use cases are possible, for example, Brandon Hall’s method for selecting an LMS (Brandon Hall Research, 2011, and Brandon Hall Group, 2012).

A solution that provides 80% of your needs out of the box is generally a reasonable target; you will probably not get everything you want without some customization, or resorting to other systems.

After making your decision, be clear in internal communications what the system can and cannot do. In other words, “promise low, deliver high”. Make it clear to all of those who will use the system in your organization what new roles and responsibilities they will have to take on due to implementing the system, and get their buy-in early on. It is unrealistic and unfair for them to expect that system administrators will do everything for them. As users of the system, they should experience tangible benefits (if they don’t, you need to reevaluate your requirements). They should understand that “to get, they have to give”.

After you acquire your new system, before you actually go live, there are a number of important steps you need to plan for, including migrating data, marketing, acceptance testing, help desk preparation, governance, and service interruptions. See Foreman (2013) for information on issues that arise when changing from one LMS to another. Lindenberg (2012) describes implementation issues for any LMS purchase situation, including how to market your new LMS to stakeholders and end users. Porto (2014) describes cultural and perception issues in migrating to a new LMS. Finally, Ryan et al (2012) describe a case study of an LMS migration.

9. For more information about LMSs

- Bersin by Deloitte
<http://home.bersin.com>
This company sells a variety of resources and services related to eLearning, including buyers guides, comparative ratings, etc. to aid in the process of choosing an LMS.
- Brandon Hall
<http://www.brandon-hall.com>
This company sells a variety of resources and services related to eLearning, including buyers guides, comparative ratings, etc. to aid in the process of choosing an LMS.
- *DOD Instruction 1322.26, Development, Management, and Delivery of Distributed Learning, June 2006.*
<http://www.dtic.mil/whs/directives/corres/pdf/132226p.pdf>
This document describes DoD requirements for content and LMSs regarding SCORM conformance.
- Edutools
<http://www.edu-tools.info/>
This community-driven site offers a variety of resources and services related to eLearning, including buyers guides, comparative ratings, etc. to aid in the process of choosing an LMS (though it mainly focuses on CrMSs).
- eLearning Guild
<http://www.elearningguild.com>
This professional membership-driven site offers a variety of resources and services related to eLearning, including buyers guides, comparative ratings, etc. to aid in the process of choosing an LMS.
- *E-learning!* magazine
<http://www.2elearning.com/>
This free magazine contains buyer's guides and articles that may be helpful for those involved in choosing an LMS.
- E-learning Centre (UK)
<http://www.e-learningcentre.co.uk/>
This site is sponsored by a non-profit eLearning consulting organization. It contains free information resources related to eLearning systems and tools, including reviews to aid in the process of choosing an LMS.
- eLearning Industry
<http://elearningindustry.com/learning-management-systems-comparison-checklist-of-features>
This site provides a list of features that can be used to compare LMS vendors.

- *Directory of Learning Tools* (Centre for Learning and Performance Technologies)
<http://c4lpt.co.uk/>
This site is sponsored by a non-profit eLearning consulting organization. It contains free information resources related to eLearning systems and tools, including reviews to aid in the process of choosing an LMS.
- Rustici Software
<http://www.scorm.com/scorm-explained/scorm-resources/>
This site provides a publicly available SCORM-conformant LMS that can be used for testing and demonstration. It also has a variety of information pages including such topics as what to ask for in your LMS RFP to ensure SCORM is what you want, need, and expect (see <http://www.scorm.com/scorm-explained/scorm-resources/what-to-ask-about-scorm-in-an-rfp/>)
- Tagoras, Inc.
<http://www.tagoras.com/catalog/association-lms/>
This consulting company has a large collection of resources for LMS purchasers, particularly oriented towards LMS use in trade and professional associations
- *TrainingIndustry.com*
<http://www.trainingindustry.com/learning-communities/lms-and-lcms.aspx>
This site has a Supplier Directory for LMSs and LCMSs, with company profiles.
- *Training Media Review*
<http://www.workplacepublishing.com/TrainingMediaReview.htm>
This membership-driven site offers a variety of resources and services related to eLearning, including buyers guides, comparative ratings, etc. to aid in the process of choosing an LMS.
- *Vendors of Learning Management and ELearning Products*
<http://www.trimeritus.com/vendors.pdf>
This free report (updated 11/11/14) provided by Trimeritus Elearning Solutions, Inc. includes a lists of LMSs and other eLearning products.

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The authors thank Jason Haag, Dean Marvin, Robby Robson, Don McIntosh, and Mike Rustici for contributing ideas and materials to this paper.

Appendix

B. Sample System Features Rating Matrix

The following is a sample of a matrix that can be used in step 10 presented in 8 *Process for choosing an LMS*. The step is described as:

Develop a system features rating matrix...that compares the systems identified in step 8 using the features list developed in step 9. Complete as much of this matrix as possible from the systems' documentation; if you need more information, ask their sales representatives for it (though beware of overblown claims—verify lofty ones independently if possible). Assign a numerical rating for each cell in the matrix, indicating degree of implementation of that feature; “0” would indicate that a particular LMS does not have that feature, and “10” indicates that it has a very robust implementation of the feature. The matrix should weight each feature according to its importance to you, enabling a rollup score for each system.

To use the matrix:

1. Replace the top row (LMS product 1, LMS product 2, etc.) with the names of the systems you have identified for consideration.
2. Replace the row names (Feature 1, Feature 2, etc.) with the names of features you have identified as requirements.
3. For each Weighting factor cell in the column to the right of the Feature name, enter a number between 1-3 to weight the relative importance of that feature to your organization (the higher the number, the more important). 1 weighting is a “must have”, 2 rating is a “should have”, and 3 weighting is a “nice to have”.
4. Research the feature information for each system and complete the cells with the number indicating the degree to which each system has that feature. We suggest 0-2, 0 being “does not have that feature” and 2 being “has implemented this feature to the fullest extent possible”. You may want to use a rubric developed by Brandon-Hall (Brandon-Hall Group, 2010) that rates the feature in terms of how “out of the box” it is. Assigning numbers to their rubric would yield the following rating scale:
 - 5=Automatic (built-in, out of the box feature)
 - 4=Semi-automatic (mostly built-in, but requires some programming or customization to activate)
 - 3=Semi-custom (partially available. The system can be adapted to implement this feature through moderate customization)
 - 2=Custom (not available but can be added, possibly at high cost, with programming)
 - 1=Not available (would be impossible or cost-prohibitive to customize the system to add the feature due to incompatibilities with system architecture, etc.)

If a feature is not available, you may also want to note in this matrix whether a feature is available from another vendor as an add-on, so as not to totally rule out/penalize the vendor for lack of that feature. This can be incorporated into the rating scale such that a rating of “3” means that a feature is available as a third party add-on.

5. The rollup score row at the bottom will provide the total weighted score for each system (right-click on it and select **Update Field** after you make any changes to the weighting values or ratings). Formulas in the cells multiply the weighting factor for each feature by the degree of implementation feature described above; those scores are then added to make the totals at the bottom of each row.
6. If you add columns or rows, copy and paste the Rollup score formula and adjust the row and column references in the formula accordingly. Right-click the pasted Rollup score and select **Toggle Field Codes** to see and edit the formula.

<i>LMS Features Rating Matrix</i>						
Feature name	<i>Weighting factor</i>	LMS product 1	LMS product 2	LMS product 3	LMS product 4	LMS product 5
Feature 1						
Feature 2						
Feature 3						
Feature 4						
Feature 5						
Feature 6						
Feature 7						
Feature 8						
Feature 9						
Feature 10						
	Rollup score	0	0	0	0	0

C. Security Considerations for DoD LMSs

The following are security considerations and requirements for any LMS that will be used within U.S. DoD. Many of these considerations apply in a more general sense to any military environment that is acquiring or installing an LMS.

- Unclassified system (NIPRNET)
- Classified system (SIPRNET)
- Certification requirements
- Customer databases
 - Defense Enrollment Eligibility
<http://usmilitary.about.com/library/milinfo/dodreg/bldodreg1341-2i.htm>
 - Reporting System
<http://usmilitary.about.com/library/milinfo/dodreg/bldodreg1341-2i.htm>
 - Army Knowledge Online
<http://www.army.mil/ako/>
 - Navy Knowledge Online
<https://wwa.nko.navy.mil/portal/home/>
 - Navy Training Management Planning System
http://www.public.navy.mil/spawar/PEOEIS/SWP/Documents/FactSheets/FS_NTMPSP.pdf
- Security Certification & Accreditation
<http://www.dtic.mil/whs/directives/corres/pdf/330513m.pdf>
- Transport Layer Security (TLS)
http://en.wikipedia.org/wiki/Transport_Layer_Security
- FIPS PUB 112 standard, Password usage, National Institute of Standards and Technology (NIST) (for user identification and authentication and DoD password management guideline)
<http://www.dtic.mil/dtic/tr/fulltext/u2/a406544.pdf>
- Public-Key Infrastructure (PKI)
<http://www.dartmouth.edu/~deployki/overview.html>
- Support for multiple levels of customizable security access
- Security considerations for private and public cloud solutions
- Cybersecurity
http://www.dtic.mil/whs/directives/corres/pdf/850001_2014.pdf
- Security System Authorization Agreement – Required by DoDI 5200.40 - DoD Information Technology Security Certification and Accreditation Process (DITSCAP)
http://en.wikipedia.org/wiki/System_Security_Authorization_Agreement

D. Sources of Possible Requirements for U.S. DoD LMS Acquisitions and Installations

- Common Human Resource Information Standards (CHRIS)
http://www.prim.osd.mil/init/listing_chris.html
- DoD 5220-M-SUP - National Industrial Security Program Operating Manual Feb 2006
<http://www.dss.mil/documents/odaa/nispom2006-5220.pdf>
- DoD Information Assurance Certification and Accreditation Process (DIACAP) Nov 2007
http://www.prim.osd.mil/Documents/DIACAP_Slick_Sheet.pdf
- NSTISSI No. 4009 - National Information Systems Security (INFOSEC) Glossary May 2003
<http://handle.dtic.mil/100.2/ADA433929>
- OMB A130 Transmittal Number 4 - Management of Federal Information Resources Various
<http://www.whitehouse.gov/omb/circulars/a130/a130trans4.html>
- Public Law 107-347– Federal Information Security Act
https://en.wikipedia.org/wiki/Federal_Information_Security_Management_Act_of_2002
- Subsection 552a of title 5, United States Code Jan 06, 2003
[http://uscode.house.gov/view.xhtml?req=\(title:5%20section:552a%20edition:prelim\)](http://uscode.house.gov/view.xhtml?req=(title:5%20section:552a%20edition:prelim))
- DODD 8500.1 Cybersecurity
http://www.dtic.mil/whs/directives/corres/pdf/850001_2014.pdf
- DoD 5200.1-R DoD Information Security Program Regulation
http://www.dtic.mil/whs/directives/corres/pdf/520001_vol1.pdf
- 44 U.S.C. § 3541, United States Code, "Federal Information Security Management Act of 2002" (FISMA)
- Defense Acquisition Workforce Improvement Act (DAWIA) (dictates keeping training records and test scores for 7 years, with caveats)
<http://www.dau.mil/doddacm/Pages/Certification.aspx>
- Federal Risk and Authorization Management Program (FedRAMP+)
<https://www.fedramp.gov/#>
- NIST 800-53
<http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r4.pdf>
- USA Learning
<https://usalearning.gov/>

E. Additional requirements for LCMSs

The following requirements are supplemental to the list of requirements presented in *5 List of possible requirements for an LMS*. If you are acquiring an LCMS, you should consider adding these requirements to that list. The criteria described here are relevant only to LCMSs, since LMSs do not normally include the content authoring and content repository features that are the hallmark of LCMSs.

If you are looking at an LCMS solution, it is important that you also focus on the requirements for content authoring features, in addition to the requirements found in this list and the list in *5 List of possible requirements for an LMS*. For a list of requirements related to authoring capabilities, see ADL's *Choosing Authoring Tools* paper at <http://adlnet.gov/adl-assets/uploads/2016/01/ChoosingAuthoringTools.docx>. The list below does not include features that are related to content authoring, to avoid repetitive overlap with the *Choosing Authoring Tools* paper.

A high-quality LCMS, in addition to the criteria presented in *5 List of possible requirements for an LMS*, will include the following features:

- **Navigation and administrative views**
 - Allows filtering of views so that you can view only a particular level of content in the hierarchy, or branch of the content tree.
 - Clearly shows where an object is being reused.
 - Allows filtering of views of content being developed, using metadata.
- **Content import**
 - Has mapping feature that allows you to indicate how the styles and items in Microsoft Office documents to be imported relate to the level of object in the LCMS. For example, an “H1” heading in a Microsoft Word document becomes a separate screen with that title.
 - Allows bulk media import (e.g., collection of media files within zip file) into content repository.
 - Imports containers that store external files, for example, a web site, with internal links between files maintained after import.
- **Creating ancillary content objects**
 - Easy to create ancillary course objects like bibliographies, glossaries, assessments.
 - For assessments, has an API that allows setting the values required to communicate scoring info between a simulation format like Flash and the LCMS.
- **Manipulating content objects**
 - Allows establishing objects at at least four levels of content object hierarchy (for example, course, module, learning object, topic).
 - Uses drag and drop as much as possible for moving objects within output structures.
 - Allows and has flexible options for orphan objects that are not assigned to parent objects.
 - Allows you to assign properties to multiple objects at once, without interfering with already existing settings.
 - Developers can lock container objects in a course even if there are child objects locked by other users.
 - Has flexible options for deleting content that is linked/ reused in other containers.

- Has templates that can be applied at all levels of course structure.
- Has robust prohibitions to maintain the integrity of relationships of objects. For example, it won't allow you to delete an object that is referenced by another object.
- Allows overriding personalization settings for individual objects (that are subject to inheritance rules from parent objects)
- Has features optimized for system training, such as built-in screen capture.
- **Content preview**
 - Has viewers that emulate the way the content will look delivered for web, print, mobile device, 508 accessible eLearning, etc.
 - Allows viewing of content dynamically as it is created, with different viewers, themes, contexts, etc.
- **Repository storage, documentation, and management**
 - Has robust features for storage, documentation, and management of content versions.
 - Can restore easily to a previous version of an object.
 - Can export assets/media from the repository easily.
 - Contains a log for all system actions taken in the repository.
 - Allows audit of data movement in and out of the repository (e.g., "process viewer").
 - Allows partition administration. This is useful where multiple organizations share the same content repository.
 - Allows synchronization of data on different servers, if multiple servers are to be networked for different data sharing needs. For example, data on a development server could be automatically updated on production servers and review servers. This requires functions that identify the servers used and the content that will be delivered from one to the other.
 - Has a task broker that manages and distributes the load put on the server by tasks initiated in the repository.
 - Exports data from the repository into a packaged XML or JSON format. This means you can export data for the entire repository, not just for a particular object.
 - Allows caching of media contained in the database, eliminating the time needed to retrieve it from the repository when content is launched.
 - Supports PENS (Package Exchange Notification Services). With PENS, you can automatically export content to a PENS server as SCORM or AICC with notification.
- **Content delivery and output formats**
 - Can set up rules for whether an object displays to the learner or not (possibly by leveraging SCORM 2004 sequencing capability).
 - Has a slideshow feature for delivery of a series of raw images.
 - Is interoperable with PDFs such that a particular page can be opened vs always opening to the first page.
 - Exports content to a variety of content formats, such as Word, PowerPoint, Framemaker.

- Incorporates viewer objects that allow dynamic configuration of the way a learner will see delivered content.
- Has an encrypted export option.
- Allows export as compiled Help (.chm format) that has TOC and index.

F. Examples of products

NOTE: *these lists are for illustrative purposes and do not constitute an endorsement by ADL. This list is not represented as a comprehensive list of all available systems.*

General purpose LMSs

- ABC Academy®
www.danishprobe.com
- Absorb LMS®
<http://www.absorblms.com/>
- Adobe Captivate Prime®
<http://www.adobe.com/products/captivateprime.html>
- BizLibrary LMS®
www.bizlibrary.com
- Bridge®
<http://www.getbridge.com/>
- Canvas® [oriented towards use by higher ed community]
<http://www.instructure.com/>
- Chamilo [open source]
<http://www.chamilo.org/en>
- CLIX®
www.im-c.com
- ComplianceWire®
www.kaplaneduneering.com
- Cornerstone OnDemand Talent Management Suite®
<http://www.cornerstoneondemand.com>
- CourseAvenue Deliver®
<http://www.courseavenue.com/>
- CrossKnowledge Learning Suite®
http://www.crossknowledge.com/en_GB/elearning/technologies/lms-platform.html
- Digital Chalk®
<http://www.digitalchalk.com>
- Docebo [open source]
<http://www.docebo.org/doceboCms>
- Dokeos [open source]
<http://www.dokeos.com>

- DuPont Sustainable Solutions LMS®
<http://www.training.dupont.com/dupont-elearning-suite/learning-management-system>
- Edubrite®
<http://www.edubrite.com/oltpublish/site/cms.do>
- EthosCE®
<http://www.ethosce.com>
- Exceed LMS®
<http://www.intellum.com/exceed-lms/>
- Brightspace Suite® [heavy emphasis on personalization and analytics]
<http://www.d2l.com/products/>
- learningCentral®
<http://www.netexlearning.com/en/learningcentral/>
- LearnUpon®
www.learnupon.com
- eFront [open source]
<http://www.efrontlearning.net>
- Flex®
<http://mobileagility.com/products/flex/>
- Google CloudCourse®
<http://google-opensource.blogspot.com/2010/05/cloudcourse-enterprise-application-in.html>
- GreenLight Learning Management System®
<http://www.silkroad.com>
- Grovo®
<http://www.grovo.com/platform>
- iCohere Unified Learning®
<http://icohere.com/>
- iLearningPLUS® [built on Oracle iLearning platform]
<http://www.seertechsolutions.com>
- ILIAS [open source]
<http://www.ilias.de>
- Infor Learning Management [formerly CERTPOINT VLS]
<http://www.infor.com/product-summary/hcm/learning-management/>
- Instancy Learning Gateway®
<http://www.instancy.com/>
- JoomlaLMS® [open source]
<http://www.JoomlaLMS.com>
- KnowledgeHub®
<http://www.elementk.com>
- KeneXa Learning Suite (formerly OutStart Training Edge)®
<http://www.outstart.com/trainingedge-lms.htm>

- KMx Enterprise®
http://www.kmsi.us/kmx_product_information.htm
- Krawler LMS®
<http://www.krawlerlms.com>
- Learning Studio®
<http://www.pearsonlearningsolutions.com/pearson-learning-studio/>
- Litmos®
<http://www.litmos.com/>
- Meridian Global LMS®
<http://www.meridianksi.com>
- Moodle [open source] [oriented towards use by academic community]
<http://moodle.com/>
- Mzinga Social Learning Suite®
<http://www.mzinga.com>
- Net Dimensions Learning®
<http://www.netdimensions.com/talent-suite/learning.php>
- NTER (National Training and Education Resource) [open source]
<http://www.nterlearning.org>
- OpenClass® [free, hosted solution]
<http://www.pearsonlearningsolutions.com/pearson-learning-studio/>
- Openlms®
<http://www.openlms.org/>
- Oracle Learning Management®
<http://www.oracle.com>
- PeopleSoft Enterprise Learning Management (ELM)®
<http://www.oracle.com/applications/>
- Saba Enterprise Suite®
<http://www.saba.com>
- SAP Enterprise Learning®
<http://www.sap.com>
- SCORM Cloud®
<http://www.scorm.com/scorm-solved/scorm-cloud/scorm-test-track-scorm-cloud/>
- ShareKnowledge LMS® (built on Microsoft SharePoint)
<http://shareknowledge.com/sk?gclid=CKXxgaLN1MECFUNp7Aod4A4Arg>
- Skilljar LMS®
<http://www.skilljar.com/>
- Skillport LMS®
<http://www.skillsoft.com/business-solutions/skillport.asp>
- SuccessFactors Learning (LMS)
http://www.successfactors.com/en_us.html

- SumTotal® TotalLMS®
<http://www.sumtotalsystems.com>
- TEDS Learning on Demand®
<http://www.teds.com/index.php/solutions/learning-management>
- TalentLMS®
<http://learn.unbundled.org/>
- Taleo Learn®
<http://www.taleo.com/solutions/learning>
- TM SIGAL®
<http://www.technomedia.com>
- Topyx®
<http://interactyx.com/>
- Totara LMS® [customized version of Moodle]
<http://www.totalms.com/>
- Training Jungle®
<http://www.redtray.co.uk>
- Training Partner®
<http://www.trainingpartner.com/LMS.aspx>
- Travitor®
<http://travitor.com>
- Trellis®
<http://home.learning.net/>
- UdutuTeach/Learn®
<http://udutu.com/products-udututeach-and-udutulearn.html>
- Veloce®
<http://www.syslps.com>
- ViewCentral®
<http://www.viewcentral.com>
- UpsideLMS®
<http://www.upsidelearning.com>
- Virtual Training Assistant®
<http://risc-inc.com/>
- WiseTail Learning Environment®
<http://www.wisetail.com/solutions/>
- WordPress LMS®
<http://www.learndash.com/>
- Xerox Learning Services®
<http://www.acs-inc.com/learning-services/learning-outsourcing/learning-administration.aspx>
- XStream RapidShare LMS®
<http://www.xstreamsoftware.com>

Mobile Learning LMSs

- Bridge®
<http://www.getbridge.com>
- Blackboard Mobile®
<http://www.blackboard.com/Platforms/Mobile/Overview.aspx>
- Certpoint VLS Mobile®
<http://www.certpointsystems.com/products-and-services/enterprise-learning-platform/mobile-learning.html>
- CourseAvenue Enterprise Mobile Solution
<http://www.courseavenue.com/>
- Flex®
<http://mobileagility.com/products/flex/>
- eXact Learning Mobile®
<http://www.exact-learning.com/>
- InKling
<https://www.inkling.com/platform/>
- Intuition Rubicon®
<http://www.intuition.com/Mobile/home.aspx>
- Instancy Mobile LMS®
<http://www.instancy.com/mobilelearning.aspx>
- KMxMobile®
http://www.kmsi.us/white_paper13.htm
- KO-SU®
<https://ko-su.com/>
- Litmos LMS®
<http://www.litmos.com/mobile-learning>
- Mobile Coach®
<http://mobilecoach.com> [delivers learning content via text messages]
- Moodle Mobile®
http://docs.moodle.org/en/Mobile_Moodle_FAQ
- NetDimensions Talent Suite Mobile®
<http://www.netdimensions.com/solutions/mobile-learning.php>
- OnPoint Digital CellCast®
<http://www.mlearning.com/>
- Train by Cell®
<http://trainbycell.com/>
- Trivantis Coursemill®
<http://www.trivantis.com/coursemill-learning-mangement-system-features>

- Upside2Go®
<http://www.upsidelearning.com/us/mobile-learning-solution-upside2go.asp>
- Xyleme Mobile Learning Solution®
<http://www.xyleme.com/solution/mobile-learning>

Specialized LMSs

- Adobe Experience Manager [social learning optimized]
<http://www.adobe.com/marketing-cloud/enterprise-content-management.html?promoid=KFBZO>
- ALTO LMS® [social learning optimized]
<http://www.commelius.com/lms/>
- Booster Learn® [spaced learning delivery platform]
<https://boosterlearn.com/science-of-booster>
- Brightcove® [video content management system – see 7.30 *Microlearning*]
<https://www.brightcove.com/en/>
- Desire2Learn® [oriented towards use by academic community]
<http://www.desire2learn.com/>
- Its Learning® [oriented towards K-12]
<http://www.itslearning.net>
- Kaltura® [video content management system – see 7.30 *Microlearning*]
<http://corp.kaltura.com/>
- Konnect® [social learning platform]
<http://originlearning.com/technology/konnect/>
- KZO Innovations® [video content management system – see 7.30 *Microlearning*]
<http://www.kzoinnovations.com>
- Mlevel® [game-based, “casual” learning platform]
<http://www.mlevel.com/>
- Mindmarker® [spaced learning delivery platform]
<http://www.mindmarker.com>
- NovoEd® [optimized for social learning]
<https://novoed.com>
- Poll Everywhere® [platform for doing live classroom polls]
<https://www.poll everywhere.com/>
- Skillaware® [performance support and learning analytics platform – integrates BPMN, xAPI, and DITA standards]
<http://www.skillaware.com>
- Skytap® [virtual training lab platform]
<http://www.skytap.com>
- Spoke® [optimized for social learning]
<http://www.unboxedtechnology.com/products/spoke/>

- TREK Learning Experience Manager® [optimized for managing coaching and “on the job” learning approaches – integrates xAPI standard for tracking]
<http://www.cognitiveadvisors.com/trek>
- Valamis® [optimized for phenomenon-based learning and learning by swarming]
<http://valamis.arcusys.com/>
- Viddler® [platform for delivering interactive video]
<http://www.viddler.com>
- Walkme® [performance support delivery platform]
<http://www.walkme.com>
- Nimble® [content distribution platform]
<http://www.xanedu.com/business>

LCMSs

- ATutor [open source]
<http://www.atutor.ca/atutor/index.php>
- Claro®
<http://www.dominknow.com/products/lcms.cfm>
- Cornerstone OnDemand®
<http://www.cornerstoneondemand.com/>
- Docebo [open source]
<https://www.docebo.com/>
- eXact LCMS®
<http://www.exact-learning.com/en/products/learn-exact-suite/exact-lcms-learning-content-management-system>
- GreenLight Learning Content Management System®
<http://www.silkroad.com>
- IBM Learning Content Management System®
<http://www.ibm.com/marketplace/cloud/learning-content-management-system/us/en-us>
- Kenexa LCMS®
http://www.outstart.com/outstart_lcms.htm
- Knowledge Guru [heavy emphasis on gamification]
<http://www.theknowledgeguru.com/>
- Mediasite Enterprise Video Platform®
<http://www.sonicfoundry.com>
- Saba Content Management®
<http://www.saba.com>
- SAP Enterprise Learning®
<http://www.sap.com>
- SumTotal LCMS®
<http://www.sumtotalsystems.com/products/learning-content-management-system.html>

- TrainingRelief®
<http://trainingrelief.com>
- Xyleme LCMS®
<http://www.xyleme.com>

CrMSs

- .LRN [open source]
<http://dotlrn.org/>
- Adrenna Academic [open source]
http://www.adrenna.com/open-source-lms#adrenna_academic
- Blackboard® [oriented towards use by academic community]
<http://www.blackboard.com>
- Canvas Network [oriented towards use by higher ed community]
<http://www.instructure.com/>
- Claroline [open source]
<https://github.com/claroline/Claroline>
- CourseCompass®
<http://www.pearsonlearningsolutions.com/career-schools/lms-cms.php>
- Coursera® [used exclusively for MOOCs]
<https://www.coursera.org/>
- Edvance360®
<https://www.edvance360.com/>
- EdX [open source, used exclusively for MOOCs; Google is contributing code. See <http://googleresearch.blogspot.com/2013/09/we-are-joining-open-edx-platform.html>]
<https://www.edx.org/>
- GoToTraining®
http://www.citrix.com/English/ps2/products/product.asp?contentID=1862273&ntref=prod_top
- Haiku®
<http://www.haikulearning.com/>
- Learning Studio®
<http://www.pearsonlearningsolutions.com/pearson-learning-studio/>
- LON-CAPA [open source]
<http://www.lon-capa.org/>
- Moodle [open source]
<http://moodle.com/>
- OLAT [open source]
<http://www.olat.org/website/en/html/index.html>
- Sakai [open source]
<http://sakaiproject.org/portal>

- WebStudy®
<http://www.webstudy.com>

VLEs

- Adobe Connect®
<http://www.adobe.com/products/adobeconnect.html>
- Collaborate®
<http://www.blackboard.com/Platforms/Collaborate/Products/Blackboard-Collaborate/Web-Conferencing.aspx>
- Centra®
<http://www.saba.com>
- Connect®
<http://www.adobe.com/products/acrobatconnectpro/>
- iCohere Unified Learning®
<http://icohere.com>
- LiveRoom®
<http://www.desire2learn.com>
- Social Learning Suite®
<http://mzinga.com/>
- WebEx Training Center®
<http://www.webex.com>
- WizIQ® [hosted service that allows the public to run their own classes]
<https://www.wiziq.com/>