

# TOWARDS AN ONTOLOGY OF LMS

## *A Conceptual Framework*

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Keywords: LMS, Ontology, Elearning Standards, LMS evaluation, LMS implementation

Abstract: Learning Management Systems (LMS) are used widely to support training in an organization. Selecting and implementing an LMS can have an impact in cost, time and customer satisfaction in the organization. Due to the existence of a variety of definitions on the subject of elearning and LMS, it is necessary a conceptual framework using an ontology. This article presents a research in progress whose final objective is to develop a method to select, implement and integrate an LMS into an organization with a systemic quality approach. As a first step, in this article is presented an ontology to conceptualize the terms associated to LMS, unifying them through their relations.

## 1. INTRODUCTION

Learning Management Systems (LMS) allow important advantages oriented to keep tracking and automate the administration of training events and support the management of learning in an organization (Hall, 2005a; Dean, 2002; Kaplan, 2005). An LMS integrates educational resources, the learners and support tools (Edutools, 2003)

An organization needs an LMS as one system to track, manage, and deliver training globally, using a common environment to all these target organizations (Martin et al, 2005).

In the last few years, there is an increased interest in the process of selecting, implementing and integrating an LMS in an organization (Fernandez, 2003; Piskurich, 2003; Papsheew, 2005). Recent studies (Howard, 2003) have shown that these processes have an impact in cost, time and customer satisfaction, and therefore in the organization. In studies made by the Bersin & Associates Research Center (Howard, 2003), found that only 30% of the companies developed their own LMS. Companies that bought the LMS, 34% were big companies or institutions that took more than a year in implementing a LMS, whereas only a 2% took less than three months. Also they found that the costs of implementation of commercial LMS in big institutions were near USD 400.000. From these data it is possible to infer that it is commonest that companies acquire LMS instead of developing it

and that once it is acquired, it turns out expensive to implement it.

In order to get an insight into these processes, an ontology on the LMS domain is proposed. This ontology allows a better understanding of the LMS concept as well as its characteristics and the latest implications in educational, business and engineering environment. This paper is part of a more ambitious project in progress that aims to estimate the systemic quality on the implementation and integration process of an LMS into an organization.

In the first part, the methodology is described followed by a description of the concepts related to LMS. After this, a unified concept model is presented and finally, conclusions and future work are presented.

## 2. METHODOLOGY

There is a growing interest on ontologies as artifacts for knowledge representation and critical components for knowledge management and electronic commerce (Brewster, 2004).

An ontology is generally regarded as a designed artifact consisting of a specific shared vocabulary used to describe entities in some domain of interest, as well as a set of assumptions about the intended meaning of the terms in the vocabulary (Guarino, 1998).

Noy & McGuinness (2001) propose the following steps to develop an ontology: 1) Determine the

domain and scope of the ontology, 2) Consider reusing existing ontologies, 3) Enumerate important terms in the ontology, 4) Define the classes and the class hierarchy, 5) Define the properties of classes—slots, 6) Define the facets of the slots and 7) Create instances.

Given the length of this communication, full details of the steps are not presented. However some activities are listed for some steps: (1) To find out the relevant terms related with the ontology, the most common and important definitions were identified for every term, (2) only the most recent studies were taken into account in order to restrict the scope, (3) there were no reuse of ontologies as none was found on this subject, (4) the most important terms are describe interactively throughout this article, specifying the hierarchy among them as well as its relations (5) at this level the properties are not specified nor are the instances created since it is not even applied to a study case.

### 3. LMS ONTOLOGY PROPOSAL

The following ontology is explored by the following subjects: (1) defining elearning, (2) defining LMS, (3) LMS, CMS and LCMS, (4) Elearning Standards, (5) LMS evaluation and

selection (6) LMS implementation.

These six subjects will be explored next.

### 3.1 Defining Elearning

Elearning concept has evolved from earlier concepts such as TBT (Technology-Based Training), CBT (Computer-based training), and others acronyms that had not agreed upon definition (Piskurich, 2003). It can be found that CD-ROM based learning, CBT, Web-based learning (WBL) and, satellite, mobile and wireless learning can be taken as elearning (Urdan and Weggen, 2000; Bowles, 2004). Bowles (2004) defines Electronic learning as a learning experience involving the acquisition or transfer of knowledge delivered or transacted through electronic means. As this definition is too broad for the purpose of ongoing research, elearning can be defined as the learning experience involving ‘the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance’ (Rosenberg, 2002). This definition includes computer networks or webs as the delivery or mediation mechanism (Piskurich, 2003).

Figure 1 shows the main terms related with the elearning definition.

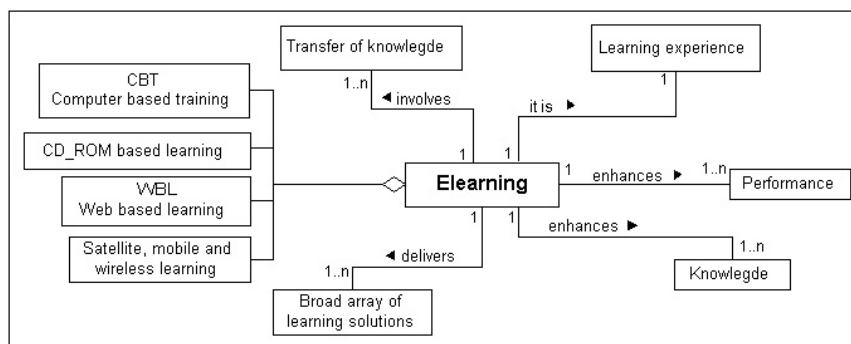


Figure 1. conceptual model for terms related to elearning definition.

### 3.2 Defining LMS

An LMS is a software package that automates the administration of training events and supports the management of learning in an organization (Hall, 2005a; Dean, 2002; Kaplan, 2005). All LMSs manage the log-in and registration of users, manage course catalogs, record data from learners, and

provide reports to management (Hall, 2005a). According to Brockbank (2003), an LMS ties six elearning components: content, collaboration, testing and assessment, skills and competency, e-commerce and Internet video-based learning in a framework that tracks, supports, manages and measure elearning activities. Kanahale (2003) states that an LMS provides the infrastructure that centralizes several components associated which each phase of the learning cycle. These three phases and their

components are: (1) *Assessment phase*: knowledge assessment, competency assessment and learning evaluation; (2) *Preparation Phase*: learning catalog, e-commerce and enrollment; and (3) *Learning phase*: learning activity, expert forum and community components.

WCET-Edutools (2005) proposes two set of tools that have to be present in a LMS: (1) *Learner tools*:

communication tools, productivity tools and student involvement tools, (2) *Support tools*: administration tools, course delivery tools and curriculum design.

Figure 2 shows the main terms related with the LMS definition.

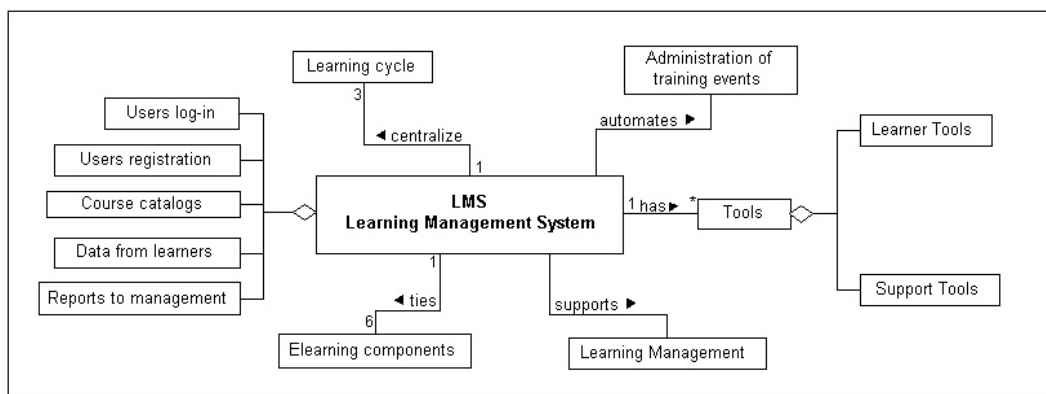


Figure 2. Concept model for LMS definition.

### 3.3 LMS, CMS and LCMS

According to Hall (2005a), Content Management Systems (CMSs) are used to store and subsequently find and retrieve large amounts of data. CMSs work by indexing text, audio clips, images, etc., within a database. In addition, CMSs often provide version control and check-in/check out capabilities. For Nichani (2001) the smallest self-contained piece of information in the CMS is the content component. Thus, in this case the reusability would be at the content component level (one content component --> many articles --> many readers). These content components when used in the learning domain are called Learning Objects (LO), or Reusable Learning Objects (RLOs). On the other hand, most LMSs don't have the ability to create instructional content, so the smallest self-contained piece of instruction in the LMS is the course itself. Thus, if there is to be any reusability, it would have to be at the course level (one course --> many learners). (Nichani, 2001). In this way, CMSs reuse content component or LOs and LMS reuse courses.

A Learning Content Management System (LCMS), is an environment where developers can create, store, reuse, manage, and deliver learning

content from a central object repository, usually a database. LCMSs generally work with content that is based on a learning object model (Hall, 2005a). These systems usually have good search capabilities, allowing developers to quickly find the text or media needed to build training content. Learning content management systems often strive to achieve a separation of content – which is often tagged in XML – from presentation (Hall, 2005a). A LCMS combines the administrative and management dimensions of a traditional LMS with the content creation and personalized assembly dimensions of a CMS. In a LCMS there are libraries of RLOs that can be used either independently, or as a part of larger instruction sets (one RLO --> many courses -> many learners) (Nichani, 2001).

The objective of a LMS and a LCMS is different: the primary objective of a LMS is to manage learners, keeping track of their progress and performance across all types of training activities (Hall, 2005b). On the other hand, the main focus of LCMSs is on achieving personalized learning on demand (LOD) to drive performance in an organization by delivering content to learners to solve business problems (Brockbank, 2003). Understanding the difference can be very confusing because most of the LCMS systems also have built-

in LMS functionality (Hall, 2005b).

In Figure 3, the terms related with LMS, CMS and

LCMS are explored.

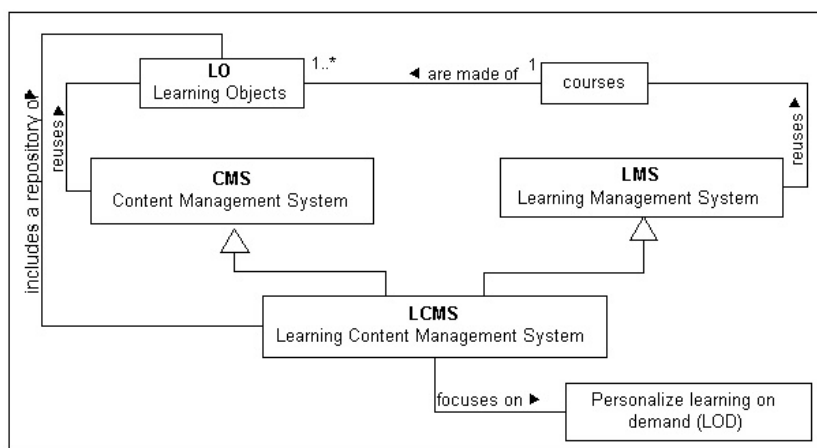


Figure 3. LMS, CMS and LCMS

### 3.4 Elearning Standards

A standard is a documented, generally accepted guideline that has been established and accepted by a board or committee to promote further industry development. Elearning standards facilitate the description, packaging, sequencing, accessibility and delivery of educational content, learning activities and learner information (Fallon and Brown, 2002).

Current proposed industry standards bodies include: IEEE LTSC, ISO SC36, AICC, IMS, ADLNet and CEN/ISSS LT.

There are presently several proposed standards but the most prominent are the standards developed by the IMS Global Learning Consortium that define the technical specifications for interoperability of applications ([www.imsproject.org](http://www.imsproject.org)). The SCORM (Sharable Content Object Reference Model) standards-in-progress integrate the industry specifications from IMS, AICC, IEEE, and ARIADNE and are operational standards with corresponding compliance test suites for learning objects. One goal of SCORM is to provide a reference model that defines Web-based learning content. ([www.adlnet.org](http://www.adlnet.org)) (WCET-EduTools, 2005).

There are three levels of standards support: compliance, conformance and certification (Brockbank, 2003). Certification is the highest level of support achieved through successful testing by an authorized, independent, third-party testing firm.

Only ADL (SCORM specifications) and AICC (AGR-010, AICC Guidelines for Web-based computer Managed Instruction) offer certifications test for LMS producers.

Figure 4 shows the main terms related with elearning standards.

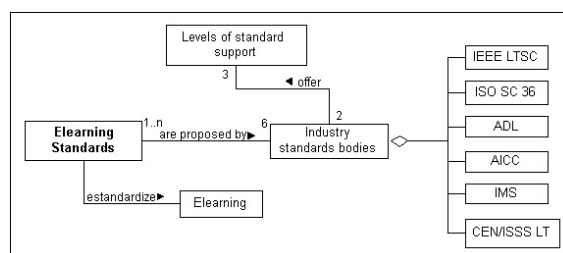


Figure 4. Conceptual model for Elearning Standards

### 3.5 LMS evaluation and selection

Before selecting the right LMS for the organization, Brockbank (2003) proposes to consider the following:

- Analyze the organization's current training and learning environment, commitment, technology and resources.
- Determine what needs must be met by an LMS.
- What existing IT training (tools, content, etc.) will need to be integrated into the LMS?
- What is the schedule for the deployment of the LMS?

Some organizations and researchers propose a preselecting process before the evaluation and final selection of the LMS that would be used in the

organization (Edutech, 2003, Edutech, 2005; COL, 2003; JOIN, 2005, Bershears, 2001, Hollander, 2000).

JOIN (2005) uses an LMS minimum definition as a first step for the preselection process, therefore, LMSs that conform to the minimum definition will be included in the final evaluation.

COL (2004) proposes to choose from open source or commercial LMS as one of the first steps.

Other preselection criteria that have also been considered are as follow:

- the LMS has been used within the country (COL, 2003; Edutech, 2003).
- the evaluation group had positive experiences with the LMS, or heard positive comments about it from others (Edutech, 2003)
- support for multiple languages (Edutech, 2005)
- server runs on multiple operating systems (COL, 2003; Edutech, 2005)
- integrated/homogeneous learning environment (Edutech, 2005)
- basic documentation is available (COL, 2003; Edutech, 2005)
- the geographical place for the LMS developers (Rosenberg, 2002, Fernández, 2003; Edutech, 2005)
- the elearning standards compliance (Rosenberg, 2002, Edutech, 2005)

Additionally, for open source LMS, these preselection criteria have been proposed:

- active development, with at least 2 full time

developers (Edutech, 2005)

- active support community (COL, 2003; Edutech, 2005)

After the LMSs have been preselected, the evaluation process begins for the final selection.

Most LMS evaluation includes the evaluation of:

- 1) *LMS features or functional requirements*: learner tools features, support tools features, interoperability and security (WCET-Edutools, 2005, COL, 2004; Edutech, 2005; JOIN, 2005; ISO/IEC 9126).
- 2) *Maintainability*: quality of technical documentation, scalability, extensibility, standard compliance (COL, 2004; JOIN, 2005; ISO/IEC 9126).
- 3) *Usability*: user documentation, generating content (COL, 2004; JOIN, 2005; ISO/IEC 9126).
- 4) *Reliability* (COL, 2004).
- 5) *Technical specification*: hardware/software, pricing/licensing (WCET-Edutools, 2005, COL, 2004).
- 6) *Others*: openness, integration capacity, flexibility, extendibility (COL, 2004; Brockbank, 2003).

In Figure 5, all terms related to LMS evaluation and selection are explored.

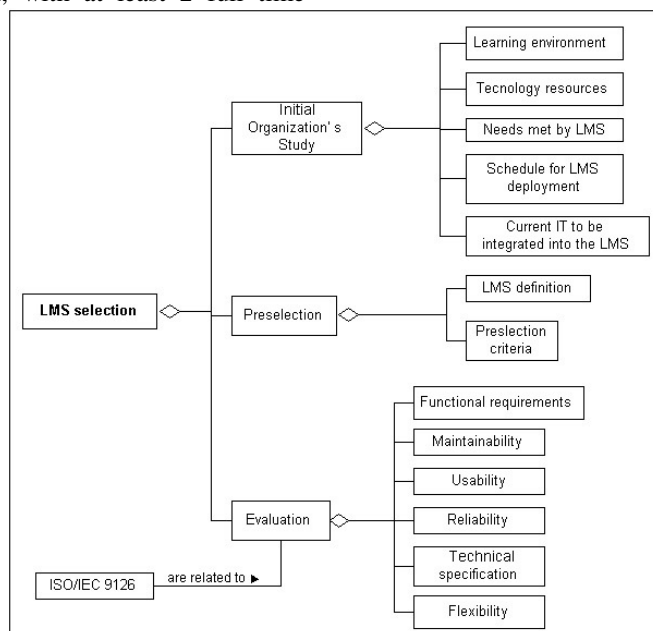


Figure 5. Conceptual model for LMS evaluation and selection.

### 3.6 LMS implementation

Papshev (2005) recommends a methodology to implement a LMS in an organization. It uses six phases: project planning, data preparation, data introduction, data migration, impact in the organization, system training and system production.

Moran (2002) considers that there are two factors of success when selecting and implementing a LMS. First, to create a Blueprint of the learning corporation that articulates clearly the present learning atmosphere and the expected future. Secondly, the costs must be adapted to the migration of data base, construction of digital connectors, development or customized migration of content and reports. Also this author suggests preparing a document of Design of Implementation.

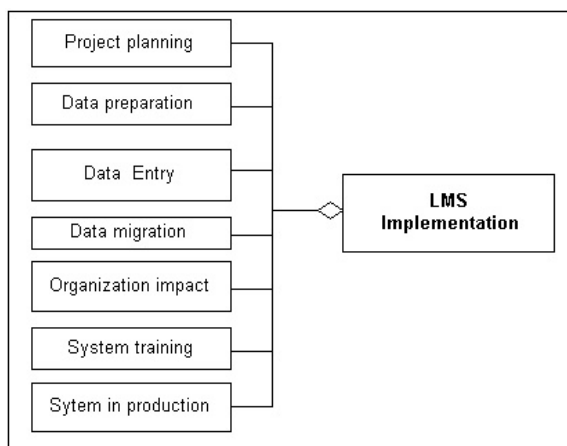


Figure 6. LMS implementation

### 4. UNIFIED CONCEPT MODEL

Once the concepts around LMS have been described separately, a unified model is presented where new relations are shown. One of the main relations is that pre-selection, evaluation and selection aspects are related to a correct definition of LMS. In this way, some implementation aspects can promote some characteristics that should be present in the required LMS.

On the other hand, when presenting/displaying all the models in a unified form, those concepts that are repeated stand out and serve as integrators between the involved parts.

Up to now, the term LMS gathers a great amount of concepts that need to be identified in order to gain a global view of the processes that are discussed in this article. Figure 7 is a unified version of the proposed conceptual model. The boxes do not imply any type of order nor relevance between concepts, they are only used to group similar concepts and to facilitate the reading of the model

### 5. CONCLUSIONS AND FUTURE WORKS

The selection of an LMS is a process that involves a pre-selection process, an evaluation methodology and an implementation process. A correct LMS definition is needed to get a better understanding of what features must conform an LMS to be considered in the pre-selection list.

To make the correct selection, several aspects should be taken into account even before starting the pre-selection process: a study of the organization's current training and learning environment, the existing IT infrastructure and the needs that must be met by the LMS. Elearning standards play an important role in the LMS selection, as well as usability, customer satisfaction and the support that the LMS suppliers can provide.

Conclusions can be summarized in two fundamental aspects:

- First steps are taken to organize and document the terms and concepts that turns around the LMS concept.

- A relation of concepts is offered to obtain a global and systemic point of view in evaluation, selection and implementation of a LMS in an organization.

Therefore, this ongoing research is oriented towards an establishment of a methodology to select and implement an LMS into an organization with a systemic approach that includes a rigorous description of the scope and conceptual framework.

Additionally, this first ontology would be applied to a study case to validate the concepts. The model would be formulated and validated applying the method DESMET, which allows evaluating methods and tools used in the subject of Software engineering. The applicability and pertinence of the model is expected to be around 75%.

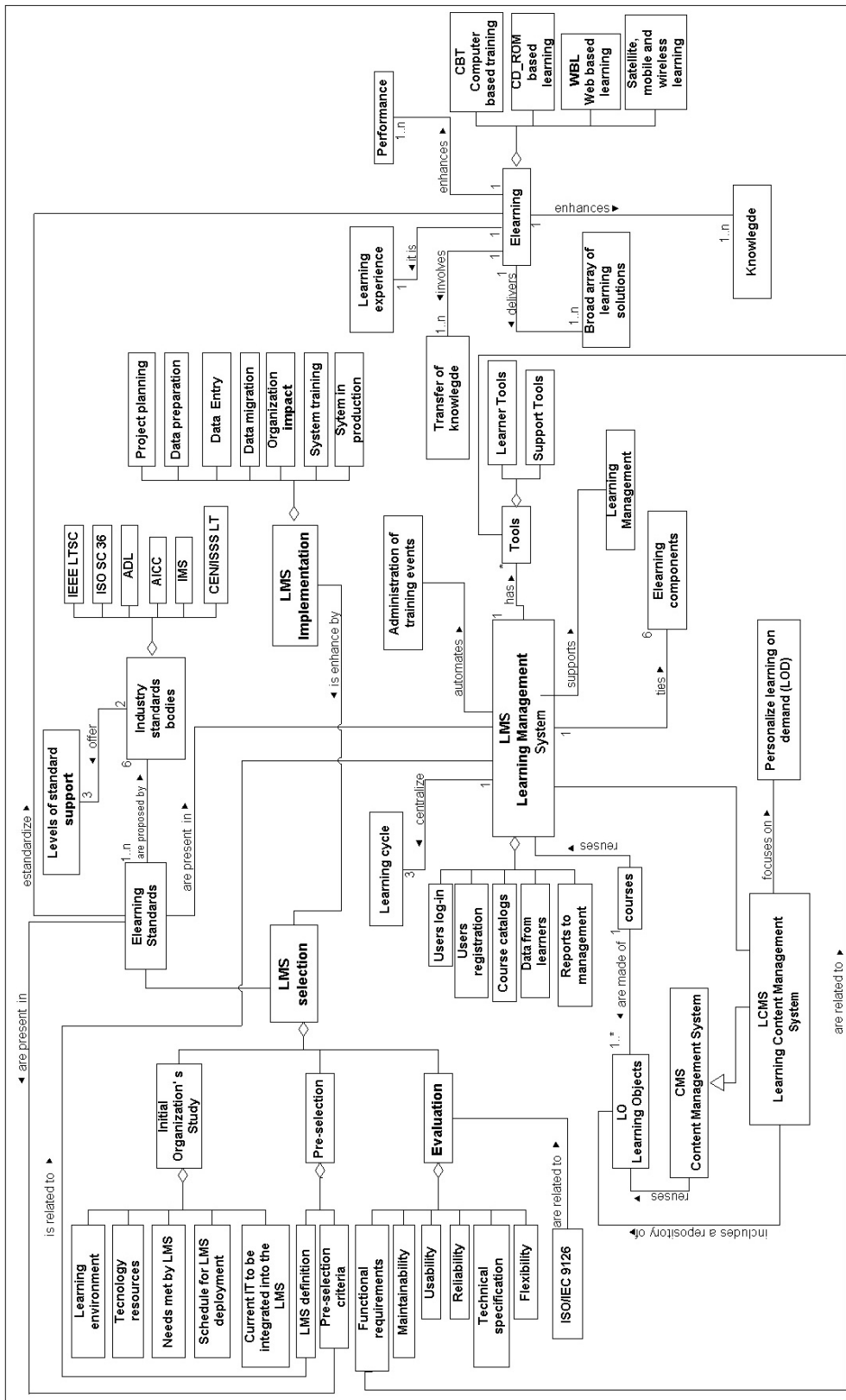


Figure 7 . Conceptual model for LMS.

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