Building an Adaptive Innovative Intelligent Corporate e-Learning System Using LMS and ITS

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Abstract:
Corporate education is altering its course from short-term skillset training, to long-term employee learning; amidst efforts to rebound from the recent global economic downturn, human capital management has never been so important to so many companies. More and more corporate jobs require employees to demonstrate problem-solving skills as opposed to performing rote tasks. Economic globalization, new regulatory requirements, and deployment of new methodologies require that employees are sufficiently trained and versatile to perform well on a variety of tasks. Ever changing technologies demand employees to stay up-to-date on knowledge, skills and common practices. As a result, there is demand for more effective and evolutionary learning systems that enable corporations to better align themselves with business needs. This is essential for the company's survival and the ability to achieve a foothold in competitive marketplaces. As much as formal, instructor-led training is not being dismissed, e-learning has risen to a prominent position in the corporate learning sphere. The paper will propose and prototype an organizational e-Learning Management System (eLMS), incorporating concepts from Intelligent Tutoring System (ITS), to meet the new demands for corporate education. Whilst maintaining the traditional top-down model – training programs, developed by Human Resources and Training Departments, are mandatorily distributed to individuals and departments, the proposed eLMS will feature an adaptive approach to corporate education. This approach enables training programs to be tailored to the individual employee's needs and skill sets, as well as to be constantly gauged against the corporate objectives and strategies. Peer-to-peer learning, collaborative learning, and social network modules add a novel edge to the system. To improve the efficacy of corporate learning, the system will adopt ITS paradigms including domain, student and pedagogical models to make the system interactive and intelligent.

Keywords
Learning Management System, Corporate Education, Intelligent Tutoring System, Organizational Learning, Learning Object.

1. Introduction

Corporations in the US have long realized the importance of retaining and training talents and therefore, spend about $200 billion dollars a year in corporate learning [1]. According to Bersin & Associates' *Corporate Learning Factbook*® 2011[2], a rebound in 2010 showed a 2% spending increase in corporate learning when compared to the prior year. Emerging from the recent years of economic recession is by no means a signal to embarking on a spending spree; corporations should carefully evaluate the available training methods and learn from the possible mistakes made erstwhile. In this paper, we will address some pitfalls made by US companies, following with ideological discussion on organizational learning. We will introduce a state-of-the-art corporate Learning Management System and an intelligent Learning Object model. We will briefly sketch out the system architecture of the conceptual system at the end of the article.

2. Why Organizational Learning?

Dodgson [3] describes Organizational Learning as: The way firms a) build, supplement, and organize knowledge and routines around their activities and within their cultures and b) adapt and develop organizational efficiency by improving the use of the broad skills of their workforces.

In his seminal management book *The Fifth Discipline*: *The Art & Practice of the Learning Organization*, Senge [4] advocates the notion of "learning organization": an organization is learning when it can bring about the future it most desires.

Unfortunately these organizational learning objectives were not well carried out in the real world. Pitfalls in previous organization training efforts and practices have been largely noticed and recently studied [5]. Nielson [6] listed six reasons why corporate training programs fail in his popular blog site. In a nutshell, many companies paid great attention to employee's professional development, but failed to draw the correlation of training programs to the company's business needs and goals. Many training programs aimed at short-term gains with a lack of long term strategic planning. In addition, there were no effective "monitoring" systems in place to measure the Return on Investment (ROI) of the training programs with respect to employees' performance and company growth.

Nielson contended: "All training programs should be completely aligned with the corporate objective. This alignment and high correlation provides the biggest return on corporate training, insuring that what is delivered has relevancy, value and effectiveness to both the employee as well as to the company."

3. How Does An Organization Learn?

In 1995, Professors Nonaka & Takeuchi [7] at Hitotsubashi University, Tokyo, developed a four stage spiral model of organizational learning, *SECI*:

- Socialization
- Externalization
- Combination
- Internalization

The featured roles played in the four stages are *tacit knowledge* and *explicit knowledge*. *Tacit knowledge* is personal, context specific, and subjective knowledge, that is subtle and difficult to communicate; whereas *explicit knowledge* is codified, systematic, formal knowledge that is easy to communicate.

"Socialization" denotes the process from tacit knowledge to tacit knowledge, in other words sharing of tacit knowledge. Socialization is often associated with group process and organizational culture.

The tacit knowledge of an employee can be transformed into explicit knowledge. This process to elicit and incorporate tacit knowledge into manuals, new systems and processes is called "externalization". Through deduction and induction, new knowledge can be created through “externalization.”

"Combination" is to map or disseminate explicit knowledge to explicit knowledge. This may refer to the process of translating grand range concepts such as corporate strategies into mid-range concepts such as department action plans.

When employees learn and “internalize” an organization's policies, procedures, or any declarative[1] and procedural[2] knowledge, they transform the explicit knowledge into tacit knowledge. Learning by doing [8] is the most effective methodology in “internalization.”

According to Nonaka & Takeuchi, organizational learning implies knowledge creation, which takes a path of socialization, externalization, combination, internalization, then socialization, externalization, combination, internalization . . . and so on, in an infinite spiral.

The following diagram delineates the organizational learning and knowledge creation process based on *SECI* model, where learning is being transferred from the individual to corporate routines.
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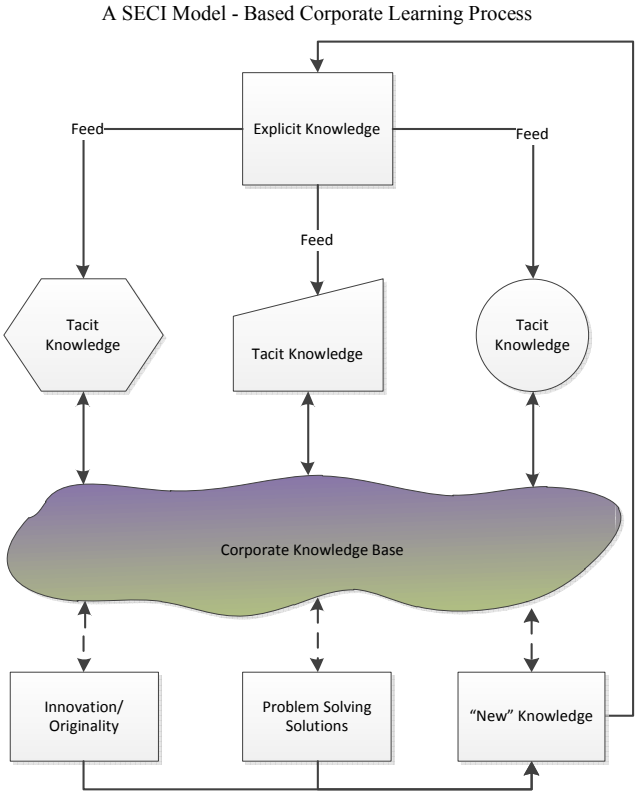

Figure 1 – A *SECI* model-based Corporate Learning Process

[1] Procedural knowledge is knowledge about how to accomplish a task.
[2] Declarative knowledge states the factual information and knowledge.

While the *SECI* model probes the process of organizational learning, Senge espouses five core disciplines of organizational learning:
1) *Personal mastery* is a discipline of continually clarifying and deepening the personal vision and seeing reality objectively (p.7).
2) *Mental models* are deeply ingrained assumptions, generalizations, or even pictures of images that influence how we understand the world and how we take action (p.8).
3) *Shared vision* is a practice of unearthing shared pictures of the future that foster genuine commitment and enrollment rather than compliance (p.9).
4) *Team learning* starts with dialogue, the capacity of members of a team to suspend assumptions and enter into genuine thinking together (p. 10). And
5) *Systems thinking* integrates the other four disciplines. In this discipline, people learn to better understand interdependency and change, and thereby to deal more effectively with the forces that shape the consequences of our actions (p. 12).

Equipped with the above learning concepts and guidelines, we strive to construct a focused and effective corporate Learning Management System (LMS) that aims at aligning learning with the corporate objectives and transforming individual knowledge into the corporate knowledge domain, applying *SECI* and the five-discipline methodologies. (Many other influential organizational learning theories, such as Argyris and Schön [9]'s single and double loop learning, play important roles in today's organizational learning studies; even though they are not regarded as the baseline theories of the proposed LMS.)

4. A Conceptual Corporate Learning Management System (ccLMS)

The key components of the ccLMS are identified as follows:

- Corporate objectives and strategies
- Corporate, department, individual learning paths
- Long term learning strategy
- Corporate knowledge base
- Monitoring and evaluation systems

The learning subjects fall into three categories:

- Administrative programs
- Corporate policies and methodologies
- Professional development programs

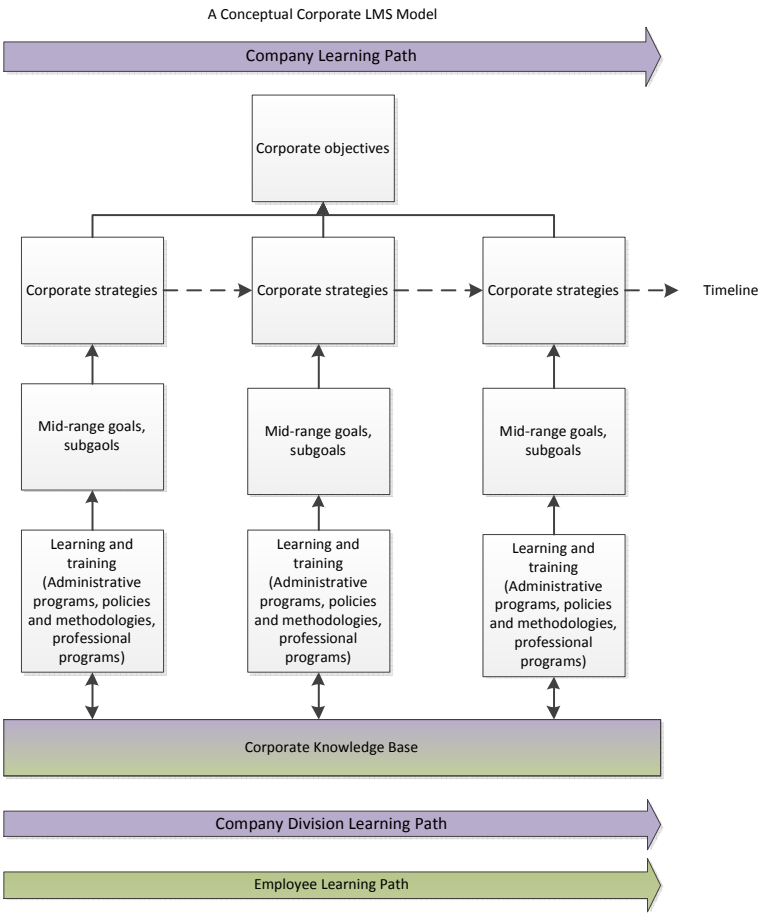

Figure 2 – The ccLMS Model (part 1)

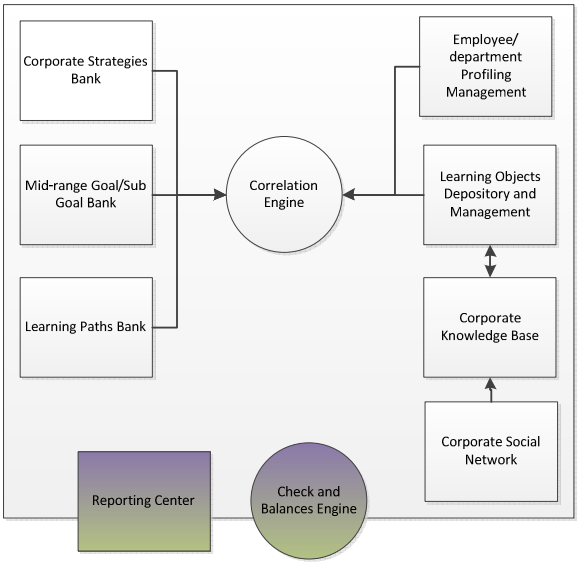

Figure 3 – The ccLMS Model (part 2)

To introduce the ccLMS, we first draw the blueprints of the paradigm.

Figure 2 illustrates a corporate learning process with a bird's eye view. The process is centered by corporate objectives and carried out through corporate strategies, strategic task breakdowns, and learning and training programs. Whilst corporate objectives are primarily steady, other goals may progress with the underlining content constantly and frequently changing. As such, the process will generate linear learning paths at various levels: company, department and individual.

The second diagram (Figure 3) outlines the functional perspectives of the ccLMS:

Corporate Strategies Bank: In each year or fiscal period, companies may roll out new or adjusted strategies to meet and respond to the late business and market needs, which should be regarded as the driven force to the organizational learning planning and design.

Mid-range Goal and Sub Goal Bank: It's a "combination" (*SECI* model) process to break the high-level strategies down into more specific goals and tasks.

Learning Path Bank: It can be either projected or ongoing learning sequences or learning objectives, which has three different levels: company, division/department and individual.

Employee/Department Profiling Management: To manage the employees and departments profile data as well as organizational learning data such as training performance ratings.

Learning Objects Depository and Management: It's the vault where all the training courses, materials and related metadata store. It's composed with many *learning objects* [10]. As a whole, the system can be regarded as one master learning object.

A *Learning Object* (LO) is a self-contained chunk of instructional material [11]. It typically includes three components: a performance goal (what the learner will understand or be able to accomplish upon completion of the learning), the necessary learning content to reach that goal (such as text, video, illustration, etc), and various forms of evaluation to measure whether or not the goal was achieved.

We will expound on this segment in Section 5.

Correlation Engine: The engine shall network and link the three banks based on relevance and weighted measurements, as well as set up the associations between a learning object and the related divisions or individuals based on their profiling data and the course metadata. The engine underlines the following three learning methodologies [12][13][14]:

1) *Course-steered learning*. Learning activity is controlled by the pre-defined course structure, which can be subscribed to or assigned to.
2) *Self-steered learning*. The learner initiates and controls the learning process himself.
3) *Context-steered learning*. The system deduces from its domain knowledge and knowledge of the learner potential knowledge gaps. It then compiles learning programs from available learning resources and recommends them to the learner. The learner can decide whether to learn now, to postpone it, or discard the recommendation completely.

The learning courses can be set with different parameters: mandatory/nondiscretionary or optional/discretionary; company wise or department wise. The system may design and recommend different "learning paths" to the employees or the departments on the one hand; the employees or the

departments on the other hands may design their own learning sequences, which gives the system a strong adaptive touch.

Corporate Knowledge Base: Everything inside the LMS, from policies, learning courses, case studies, to drop box, and tips to solve a problem, is to be found in the knowledge base. A corporate knowledge base is unique and treasurable, for it provides the corporation's identity and intellectual worth.

Corporate Social Network Space: This is the "innovative" component of the system. It is where learning collaboration, team work and team building take place. Employees can communicate with each other, or with a group of people, via forum, chat room, web conferencing, etc. It is likely the birth place for new ideas, solutions, methodologies and originalities for the company. "Socialization" (*SECI* model) occurs here.

Check-and-Balances Engine: The engine acts as a monitoring system that it analyzes the metadata collected through the learning processes through performing an "intelligent" (rule based) calculation to verify and evaluate the effectiveness of the learning programs and the individuals' performance.

Reporting Center: To provide search, aggregation, segregation and visual representation of the system data and analytical reports.

5. The Intelligent Learning Object (iLO)

In this section, we will focus on how to build an iLO, in which we will engage the concept of Intelligent Tutoring System (ITS) [15] from Artificial Intelligence (AI) discipline.

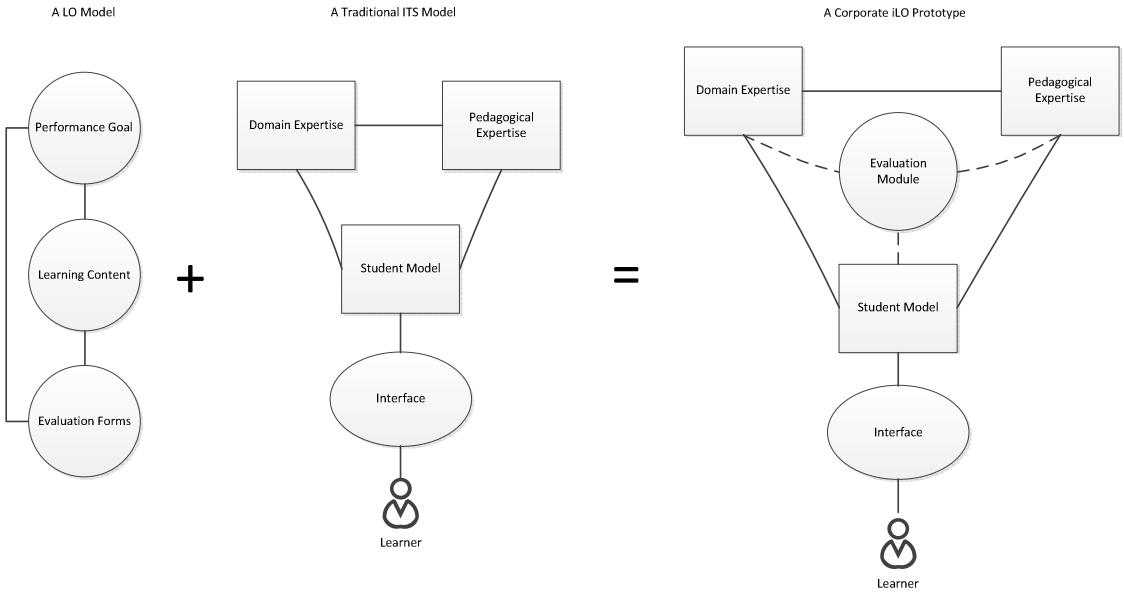

Figure 4 – The iLO Prototype

ITS is commonly considered as a knowledge communication tool, comprising four modules: Student Model, Domain Expertise, Pedagogical Expertise and Interface [16] [17].

1) *Student Model*: to gather data from and about the learner (employee). It captures the employee's learning pattern.

2) *Domain Expertise*: In a corporate context, there will be three main domain areas: administrative domain, company methodologies and policies, and professional development subjects. The module generates questions, explanations and responses, as well as provides a standard for evaluating the student's performance.
3) *Pedagogical Expertise*: According to Wenger [18], when "learning is viewed as successive transitions between knowledge states, the purpose of teaching is accordingly to facilitate the student's traversal of the space of knowledge states." Since the corporate learning domain captures mostly informative knowledge, the pedagogical model shall provide a mnemonic tutoring approach. The model helps share the learning responsibility between the learner and a dedicated "e-tutor".
4) *Interface*: to allow communication between the learner and the other aspects of the system. It is also considered as knowledge representation.

In our proposed iLO model (see Figure 4), a fifth element – Evaluation Module – is introduced to the system. For the most part, the intelligent agent [19] (Evaluation Module) will:

- Recommend pre-requisite knowledge and further learning areas to the learner
- Record pre-condition before learning of the learner
- Record learning pattern of the learner
- Evaluate post-condition after learning of the learner
- Record self-assessment and feedback of the learner

Additionally, the agent provides means to evaluate a Learning Object's effectiveness and efficiency based on metadata collected from all learners of the iLO.

6. The System Architecture Prototype

Today, the internet/intranet is the place for corporate employees to stay connected. The LMS therefore has to be an e-LMS and the iLO shall be web-based and can be deployed in mobile platforms.

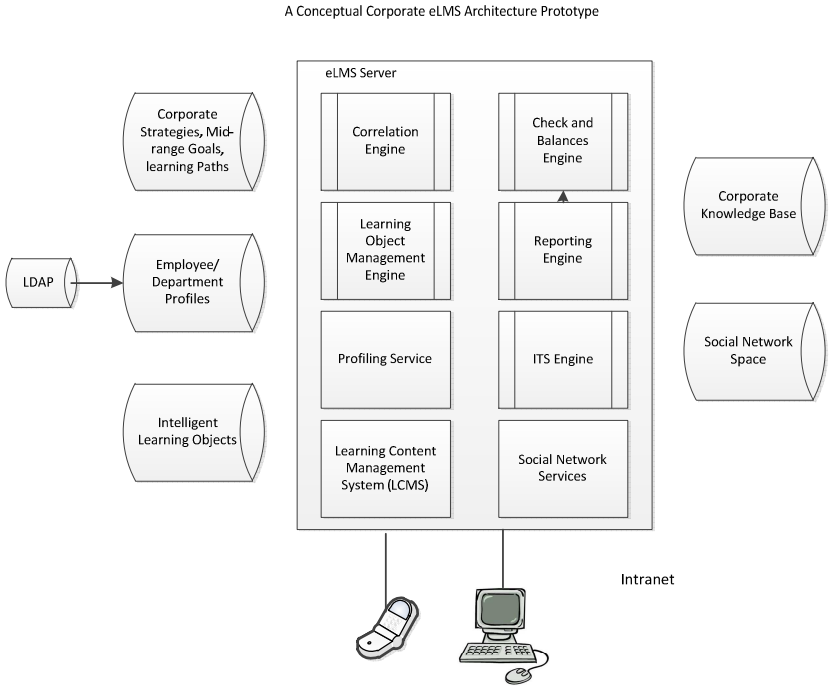

Figure 5 – The eLMS System Architecture Prototype

The system shall reside in the company's intranet subnets, since the information shall be kept confidential. The eLMS server is component-based that more or fewer components can be arranged or re-arranged inside the server container. The protocols of each component should conform to the public standards and specifications. For example, the iLO shall be SCORM[3] compliant. The LDAP server refers to the company's employees and organizational structure database system. The Learning Content Management System (LCMS) is an application to create the iLOs and any types of data entry forms.

7. Conclusions and Ongoing Work

The LMS system proposed in this paper is by no means a complete or thorough system, but rather a high-level conceptual model that each aspect can be unfolded with depths and breaths, especially considering LMS is such an interdisciplinary subject. The paper nevertheless offers a fresh look at the organizational learning and organizational LMS, which may lead to further investigation and discussions.

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