Towards Metrics for the Assessment of Web-Based Education

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Abstract - The engineering process of web-based education (WBE) is a complex task that incorporates organizational, administrative, instructional, and technological risks. Current researches are focusing on technological and pedagogical aspects of web based learning systems. However, the development, implementation and evaluation of web-based learning need to be grounded in sound processes in order to foster the achievement of expected results. To this end, we propose the application of an e-Learning Governance Reference Model – eLGORM [1], which is independent of technical platforms, organizational structures and pedagogical frameworks to help in guiding and optimizing e-learning initiatives and developments in corporations. Our Reference Model conceptual framework encompasses an e-learning information architecture, processes and sub-processes and governance rules and metrics. In this paper, we show its proposed processes and sub-processes and how metrics can be applied to help in minimizing the different types of risks present in web-based learning systems and in achieving quality and efficiency in WBE. We need some measures to tell us whether processes are functioning properly and whether they are likely to achieve their goals. To this end, critical success factors for getting these processes under control are established, while key goal Indicators are needed for monitoring achievement of e-learning process goals, as well as Key Performance Indicators for monitoring performance within each e-learning process. Further research is being carried out in the Database Lab at PUC-Rio to specify the Reference Model in detail.

Key –words: WBE, e-Learning Processes; e-Learning rules and metrics; risk management

1. Introduction

There is no doubt that e-Learning is critical to the success of individuals, organizations, communities and economies in the knowledge age. As such, the adoption of e-learning is widespread among institutions despite the fact that it remains a difficult task to ensure the quality and effectiveness of content delivered and the efficiency in the use of institutional resources.

As some authors have pointed out [2 – eL maturity model], the development, implementation and evaluation of web-based learning systems (or e-Learning?) requires that technical, pedagogical and organizational aspects be considered. What is needed is an overall institutional framework to help in the coordination of efforts across the institution as well as a methodical reference to serve as a guide for e-learning adoption, implementation and optimization. The application of e-learning governance principles will help establish the foundation for successful e-learning.

e-Learning governance can be defined as the responsibilities and practices carried out with a view to providing strategic direction to an institution’s e-learning initiatives, ensuring that established objectives are achieved and risks managed properly, as well as that resources allocated are used responsibly [3 monografia do eLGORM na PUC].

Many organizations are still experimenting with e-learning, using different approaches, applying different technologies and models for the delivery of e-learning contents. But how to ensure a successful e-learning? As stated in [4 - Winning the e-learning race], implementing e-learning is about project management, change management and risk management.

Too much work has been devoted to develop excellent tools and techniques aimed at addressing specific educational and technical needs. However, more attention should be given to guide in the
adoption of an institutional approach that can integrate all the needed considerations. eLGORM [1 –tese de doutorado] was conceived and developed with this intention.

This work specifically focus on the application of eLGORM’s processes and governance rules and metrics, so that different types of risks encountered during the development, implementation and evaluation of web-based systems can be minimized and e-learning processes results maximized.

The remainder of this paper is organized as follows. In Section 2, related research is mentioned what allows us to show the innovative nature of our work. In Section 3, an overview of eLGORM is given. We also present the basic concepts needed to understand the remaining sections. In Section 4, the proposed e-learning processes and sub-processes are presented in detail. In Section 5, we give examples on how eLGORM’s rules and metrics can be applied to some processes presented in the previous section. Finally, in Section 6, some concluding remarks are made.

2. Related Work

The term e-Learning governance was first conceived at a doctoral thesis proposal as a major theme for research about one year ago. Since then, we have not identified in the literature any academic research concerned with applying the governance principles [ ref ] to the e-learning arena. However, we found other researchers who share the same concerns of us.

In [2 - eL Maturity model], the authors mention that institutional leaders are recognizing the need for a clear vision and an integrated strategy for e-learning. The issue of e-learning added value, sustainability and return on investment are deserving increasing attention. They believe that a process model is needed to guide the improvement of e-learning independent of technical platforms, organizational structures and pedagogical frameworks. In order to develop such a model, they apply the known Capability Maturity Model or CMM in the domain of e-learning. They present a framework that indicates a set of possible outcomes for defining each of the possible levels in a maturity model.

Following this, the same authors develop a second model [5 - apply SPICE to e-learning] to help institutions in the identification of systemic weaknesses in their e-learning development, delivery and management. In this paper they show how this eMM (Marshal and Mitchell 2002,2003) Model could be applied in the evaluation of institutional e-learning capability. This is done based on a set of eMM process categories with a corresponding evaluation degree (from not adequate to fully adequate) that will help to classify each process capability in a certain maturity level.

Another work related to ours is found in [6 - ANTA]. This guide was developed by the Australian National Training Authority (ANTA) to help auditors in reviewing the quality of online materials and verifying the compliance with the Standards for Registered Training Organizations.

We can observe from the above the following commonalities with our work. As for eLGORM processes and maturity levels, [2] and [5] seem to share the same concerns. They try to establish a set of processes and maturity levels to help in the adoption and implementation of e-learning. As for eLGORM’s rules, ANTA [6] is concerned with the establishment of standards to help in auditing the quality of online materials. This is part of eLGORM’s rules and metrics scope.

One should note the completeness of eLGORM, in that, based on its seven components, it helps in the establishment of an overall institutional foundation which articulates efforts at all levels and foster the coordination of different aspects involved in e-learning. The following section gives an overview of eLGORM.

3. eLGORM Overview

In this section, we describe briefly the eLGORM’s components.

A Reference Model is “a framework for understanding significant relationships among the entities of some environment, and for the development of consistent standards or specifications supporting that environment” [7 - OAIS Reference Model].

eLGORM encompasses the following components: Purpose, Applicability, Audience, Terminology, Roles and Responsibilities, Conceptual Framework and Maturity Models. See Figure 1

Figure 1 – eLGORM’s Components

eLGORM’s conceptual framework is the most important component of the Reference Model. It
proposes e-Learning processes, information structures and governance rules and metrics. See Figure 2.

![Figure 2 – eLGORM’s Conceptual Framework](image)

In the next Section, we will describe the processes proposed for the development, implementation and evaluation of web-based learning systems.

### 4. Applying eLGORM in th Development, Implementation and Evaluation of Web-Based Learning Systems

Based on the Deming Cycle [8- Livro doBSC ], we structured the e-Learning governance processes into: Corporate e-Learning Program Planning, Corporate e-Learning Program Execution and Optimization of e-Learning processes. See the scheme below.

**E-Learning Corporate Program Planning**

- Organizational Analysis
  - Business Objective Analysis
  - Performance and Learning Analysis
  - Technical Needs Analysis
  - Readiness Analysis
- e-Learning Strategy Formulation
  - Performance and Learning Strategy
  - Content Strategy
  - Technical Strategy
  - Readiness Strategy
  - Roles, Responsibilities and Accountability Strategy
  - Processes, Systems and Structures Strategy
  - Communication Strategy
  - Measurement Strategy
- e-Learning Corporate Program Elaboration
  - E-Learning Projects Proposal
  - E-Learning Annual Plan Elaboration
  - Hardware and Software Selection, Acquisition and Installation
  - Policies and Procedures Establishment
  - Responsibilities Assignment and Approval Levels Definition
  - Governance Rules and Metrics Definition

**E-Learning Corporate Program Execution**

- e-Learning Projects Planning
  - Project Information Collection
  - Project Deliverables Listing
  - Project Schedule Definition
- e-Learning Projects Development
  - e-Learning Projects Instructional Design
    - Analysis
    - Design
    - Development
    - Delivery/Use
    - Evaluation
- e-Learning Projects Monitoring
  - Progress Report Issuing
  - Job Critique Form Issuing
- e-Learning Corporate Program Review

**E-Learning Processes Optimization**

- Process Results Monitoring
- Internal Auditing
- External Auditing

### 4.1 Corporate e-Learning Program Planning

The processes described below are based on [1, 9].

#### 4.1.1 Organizational Analysis

Prior to developing an e-Learning strategy, the institution must understand where it is. So, the first step is to conduct an organizational analysis to determine the business objectives, the learning and performance requirements, technical needs and stakeholders group’s readiness.

#### 4.1.2 e-Learning Strategy Formulation

The institution should formulate an e-Learning strategy based on the results obtained in the previous step. In line with the business objectives, a learning and performance strategy should address the performance gaps of the organization and propose the best learning methods to achieve them. A content strategy would consider what content should be developed, and if it is of high-quality and engaging. Also, a technical strategy should consider issues such as the functional needs of the organization, the architecture for the e-learning solution, current infrastructure, integration requirements etc. Parallel to this, a readiness building strategy starting from an institution’s vision of e-learning should ensure
commitment and buy-in from the various stakeholders and consider issues of resistance. Also a roles, responsibilities and accountability strategy should propose the existence of a high-level steering committee to look over the e-learning endeavours and ensure that job assignments are adequate and personnel are held accountable for results. Furthermore, a capability strategy should consider the skills and attitudes that are needed for employees to use web-based learning systems. Also a processes, systems and structures alignment strategy would consider those administrative processes which need to be changed to cope with new ways of learning, performance appraisal systems may need to be reviewed to encourage a new learning culture. A communication strategy should then be formulated so that employees are aware and commit with the e-Learning Program. Finally, a measurement strategy would provide the means to monitor the results of e-learning efforts and help in the identification of needed improvements.

4.1.3 Corporate e-Learning Program Elaboration

Based on the organizational analysis and the strategies formulated, a high-level steering committee will develop an Corporate -Learning Program which proposes e-Learning projects with corresponding priorities and establishes the overall guidelines for the institution. This is followed by the elaboration of the e-Learning Annual Plan with the projects to be undertaken during the year with corresponding costs, benefits, risks etc for further monitoring. The selection, acquisition and installation of hardware and software are part of the overall process of establishing an e-Learning Program. The selection of a Learning Management System and the platform solution as well as the development of new applications to support the institution’s e-Learning needs should be directly assisted by the Information Technology department. The establishment of policies and procedures to help in the implementation of the corporate e-Learning Program are very important. This encompasses items such as and e-Learning corporate policy, an instructional design methodology to help ensure the quality of e-learning modules etc. The assignment of roles and responsibilities and definition of reporting lines are also part of the administrative infrastructure. Finally, the establishment of governance rules and metrics are also an important sub-process to be undertaken. Section 5 illustrates some of these rules and metrics.

4.2 Corporate e-Learning Program Execution

Once the technical and administrative infrastructure is established, the implementation of the e-Learning Annual Plan should be initiated.

4.2.1 e-Learning Projects Execution

A project manager is assigned to coordinate the activities needed to implement the e-learning projects listed in the Annual Plan. He or she is responsible for providing the guidelines for each individual project and monitoring its results. Based on this, he or she will report the accomplishments to a higher-level steering committee.

4.2.1.1 e-Learning Projects Planning

As part of this step, the project manager should elaborate a work plan together with the team, while assigning individual responsibilities and estimated mandays for task completion. Collecting relevant information for the e-learning projects, listing the deliverables and establishing a schedule are part of his/her duties.

4.2.1.2 e-Learning Projects Development

Based on the established work plan, the team will carry out the tasks needed to develop the e-learning modules. It should be noted that the annual plan has \( n \) e-learning projects that may have \( n \) e-learning modules. A sound instructional design methodology is needed to produce high-quality e-learning modules. In [10 - paper do Havaif], we propose an eclectic methodology – ISDMeLO - grounded in learning theories to guide this sub-process.

4.2.1.3 e-Learning Projects Monitoring

Monitoring the results of the e-Learning projects is fundamental to help ensure that business objectives are achieved and costs and deadlines are met. Based on the information provided by the team and his/her observations, the project manager should issue a monitoring report for each e-learning project that will help in the consolidation of the yearly results and final reporting to the steering committee. Also, the issuing of a job critique form will help improve the quality of the next projects and identify the skills gap of the project team.

4.2.2 e-Learning Corporate Program Review

This process takes place based on the projects consolidation made by the project manager. The steering committee will evaluate the actual results vis-à-vis the annual plan and make the changes needed. The project priorities may be changed as a result of this process.
4.3 Optimization of e-Learning Processes

This can be done by management itself or by an internal auditing group or still an external auditing group. It should be noted that the main objective of this process is to help in the optimization of all processes so that the efficiency of the Corporate e-Learning Program is increased. The monitoring of process results by management can be done using the Balanced Scorecard indicators [8 – Livro do BSC]. An internal auditing activity will review the controls established by management to ensure that risks are addressed properly. This includes verifying if established programs and plans are in line with the business objectives, reviewing the adequacy of procedures to carry out the e-learning projects and develop the e-learning modules. The auditing will then recommend improvements to be implemented by management. An external auditing activity will also review the processes and controls and may assign a maturity level so that the institution will be able to assess and compare itself to similar.

5 Governance Rules and Metrics for Web-Based Learning Systems

In the previous section we presented the application of eLGORM’s processes in the development of web-based learning systems. We can observe that they encompass organizational, administrative, instructional, and technological sub-processes. In carrying them out, risks of different nature are present which need to be minimized by control measures. In this section we will give some examples on eLGORM’s metrics that can be applied in the processes described above. They are [1] and [11-Business Risk Assessment]:

- **Critical Success Factor**: The most important things or actions for management to achieve control over and within a process.
- **Key Goal Indicator**: Define measures that tell management whether a process has achieved its business requirements.
- **Key Performance Indicator**: Define measures to determine how well the process is performing in enabling the goal to be reached.

5.1 Organizational Aspects

For the sub-process Organizational Analysis, and considering its purpose, the following governance rules and metrics may apply:

**Purpose**: To assess the institution’s current situation in order to determine its readiness for the e-Learning adoption/implementation.

<table>
<thead>
<tr>
<th>RISKS</th>
<th>CONTROL STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• the analysis may be incomplete and incorrect</td>
<td>• to establish procedures to be followed in the analysis of the current situation</td>
</tr>
<tr>
<td>• the source for the analysis may be outdated</td>
<td>• a high-level steering committee should review the results of the analysis</td>
</tr>
<tr>
<td>• personnel to be interviewed may offer resistance</td>
<td>• a management communication should be issued requesting personnel participation</td>
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5.2 Administrative Aspects

For the sub-process e-Learning Projects Planning, and considering its purpose, the following governance rules and metrics may apply:

**Purpose**: To plan and manage the execution of the e-Learning projects approved in the Annual

<table>
<thead>
<tr>
<th>RISKS</th>
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<tbody>
<tr>
<td>• the lack of procedures to guide the various phases of project management</td>
<td>• a project management methodology should be established and followed</td>
</tr>
<tr>
<td>• lack of the content expert involvement</td>
<td>• clear definition of roles and responsibilities as well as approval requirements</td>
</tr>
<tr>
<td>• delay in the delivery of the e-learning project</td>
<td>• mechanisms should be established to monitor each project phase</td>
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5.3 Instructional Aspects

For the sub-process e-Learning Module Instructional Design (Content Design), and considering its purpose, the following governance rules and metrics may apply:

**Purpose**: To specify the e-learning module into learning objects (LO) with corresponding instructional strategies.

<table>
<thead>
<tr>
<th>RISKS</th>
<th>CONTROL STANDARDS</th>
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<tbody>
<tr>
<td>• the content developed may not be relevant for the performance gap to be solved</td>
<td>• the content expert management should ensure that content to be developed is relevant to address the performance gap</td>
</tr>
<tr>
<td>• an excessive number of LOs generating additional effort for metadata</td>
<td>• LO design guidelines should be established and followed during module</td>
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Proceedings of the 10th WSEAS International Conference on COMPUTERS, Vouliagmeni, Athens, Greece, July 13-15, 2006 (pp272-277)
### 5.4 Technological Aspects

For the sub-process **Hardware and Software Selection, Acquisition and Installation**, and considering its purpose, the following governance rules and metrics may apply:

**Purpose:** To establish a technical infrastructure commensurate with e-learning activities

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<tr>
<th>RISKS</th>
<th>CONTROL STANDARDS</th>
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<tr>
<td>• the capacity of the platform may not meet the user’s needs</td>
<td>• procedures should be established to ensure that service level evaluations meet the institutional needs</td>
</tr>
<tr>
<td>• the authoring tools selected may not integrate well with the other information systems</td>
<td>• clear criteria should be established for the acquisition of software tools to ensure their integration with other systems</td>
</tr>
<tr>
<td>• unauthorized access to e-learning modules by outsiders or insiders</td>
<td>• a clear security policy and access control is to be established to protect the institution’s e-learning contents</td>
</tr>
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</table>

### 6. Conclusion

In this paper we have shown that the development, implementation and evaluation of web-based learning is a challenging task that incorporates organizational, administrative, instructional, and technological aspects. We proposed the application of eLGORM’s processes and metrics to minimize risks of different nature involved in e-learning and to maximize the results of initiatives. As pointed out by many authors, there is a need for a methodological approach in the development of web-based learning systems and for the evaluation of results arising from e-learning endeavours. We incorporated in eLGORM the BSC scorecards to serve as metrics for the proper evaluation of WBE. This could be done because we have mapped e-learning processes and sub-processes so that the adequate metrics are applied to indicate if processes are functioning as intended and/or achieving the expected results. This contributes to ensure the quality and efficiency of WBE.

This work which is also a contribution to the PGL Project, is still underway in the Database Technology Lab (TecBD) at PUC-Rio.

### 7. Acknowledgement

The authors would like to thank the TecBD people at PUC-Rio who actively participated in the discussions.

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