Comparative Analysis for Cloud Based e-learning

Fekry Fouad Ahmed
Deanship of Admission and Registration
King Abdul Aziz University, Jeddah, Kingdom of Saudi Arabia

Abstract

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices and utilities. IT projects in any learning organization at a strategic board level and not—as before—just. e Learning systems usually require hardware and software resources. Many educational institutions cannot afford such investments. This paper highlight the contribution of E-Learning standards with the Cloud standards and the impact on using cloud computing for e-learning solutions. An analysis for the prominent issues in current e Learning systems through a comprehensive comparison between e Learning systems before and after moving to Cloud Computing environment, using a generic framework for “Cloud-based e Learning systems.

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Keywords: Cloud Computing, e Learning, Service Model Saas, IaaS, PaaS, ELaaS.

1. Introduction

A search of the literature on cloud computing and e-learning has been disappointing because no enough studies directly address effectiveness issues related of joining the cloud computing standards with the e-learning, especially when we consider cloud computing the extension of SOA out to cloud-delivered resources, of course so many papers and researches found, all goes around either the technical issues (hardware, software, networking) or the cloud computing as an effective tool to reduce the overall cost of e-learning in the long term and more cost-effective to the institution, very few papers go around cloud standards as a service model regardless the e-learning as one of the important service model.
Cloud computing mainly is a delivery of computing as a service rather than acquiring IT products, whereby shared resources, software, and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet). [1] Cloud computing providers offer their services according to three fundamental models: Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). In the main time the "Education and Learning as a Service" (ELaaS), emphasizing its possible benefits and offerings. It is essential for an educational and learning organization, with its budget restrictions and sustainability challenges, to use the cloud formation best suited for a particular IT activity [2].

Cloud computing is the mechanism of moving the processing effort from the local devices to the data center facilities. The software is commonly known as a group of services, applications and data are stored on multiple servers that can be accessed from the Internet, same time most of the education organization do not have the resources and infrastructure needed to run top e-learning solution. This is why the random / haphazard teaching media became the biggest players in the field of e-learning software, although having now versions of the base applications that are cloud oriented. The base layer of e-learning cloud shares IT infrastructure resources and connects the huge system pool together to provide services. Cloud Computing allows the hardware layer to run more like the internet, to make the hardware resources shared and accessed as data resources in secure and scalable way. Virtualization technology separates the physical hardware from operating system, which on one hand can make computing and storage capacity of the existing server into smaller size and re-integration, to improve the utilization and flexibility of IT resource; on the other hand can provide a common interface for large-scale cloud computing integration that enables the publication of calculation.

Hence, this paper introduces cloud computing into an e-Learning within the enterprise architecture standards not only as cost effective tools but for the integration of the standards of Service-Oriented Architecture (SOA) as a way of structuring and integrating IT services including the e-learning as a services , ELaaS.

2. E learning standards
Recently there have been efforts to define standards for the e-learning contents and e-learning components like the IEEELOM, UKLOM, IMS, SCORM and OKI [3]. e-Learning, like almost every other technology, has a number of evolving standards which are relevant. The Dublin Core started in 1994 to develop a meta-data framework for web resources,[4] The Dublin Core is a metadata element set intended to facilitate discovery of electronic resources, some institutions of higher education and their vendor partners established an effort to develop open, market based standards for on-line learning, including specifications for learning content metadata. Also in 1997, NIST (National Institute for Standards and Technology) and the IEEE P.1484 study group (now the IEEE Learning Technology Standards Committee – LTSC)[5] began similar efforts. The NIST effort merged with the IMS effort, and the IMS began collaborating with the ARIADNE project, a European project with active meta-data definition effort. In 1998 IMS and ARIADNE submitted a joint proposal and specification to IEEE, which formed the basis for the current IEEE Learning Object Meta-data (LOM) base document.

3. Cloud computing services [6]
IaaS
Infrastructure layer corresponds to IaaS infrastructure services, is the lowest layer of the network. Users can household to provide standard services, including computing power and storage resources. It turn the memory, storage and computing power into a virtual whole resource pool for the entire industry to provide the required of computing power and storage resources.

PaaS
Platform layer correspond to PaaS(Platform as a service) that made a higher level of abstraction on the base of laas layer.to Provides a development environment, test environment, server platforms and other services, users can develop applications based on Internet and other servers service providers infrastructure, then share it to other users.

SaaS
SaaS(Software as a service) is a software distribution model, designed for web delivery, user can deploy and access through the Internet hosting. SaaS providers need to build information for all network infrastructure,
software, hardware, operating platform, and is responsible for the implementation of all post-maintenance and other services.

Compared with the traditional method of service, Saas not only reduces the cost of traditional software licensing, and vendors deploy application software on a unified server, eliminating the end-user's server hardware, network security devices and software upgrade and maintenance expenses, the customer does not need other IT investment in addition personal computers and Internet connections to obtain the required software and services.

### Cloud clients

Users access cloud computing using networked client devices, such as desktop computers, laptops, tablets and smartphones. Some of these devices - cloud clients - rely on cloud computing for all or a majority of their applications so as to be essentially useless without it. Examples are thin clients and the browser-based Chromebook. Many cloud applications do not require specific software on the client and instead use a web browser to interact with the cloud application. With Ajax and proper browser these Web user interfaces can achieve a similar or even better look and feel as native applications. Some cloud applications, however, support specific client software dedicated to these applications (e.g., virtual desktop clients and most email clients). Some legacy applications (line of business applications that until now have been prevalent in thin client Windows computing) are delivered via a screen-sharing technology.

### 4. Views of Framework for cloud based e-learning

In this case, a framework that can describe e Learning-Cloud integration implications is necessary. But there’s few discussion directly on integrating conventional e Learning System and cloud services. Therefore, integrating about e Learning System and integrating about different cloud services are recounted respectively.

The E-Learning Framework Designing an e-learning framework needs careful analysis and investigation of the resources available to the institution. Asserts that design, development, implementation and evaluation of e-learning systems require thoughtful analysis and investigation of how to use the attributes and resources of the Internet and digital technologies. Khan further reflects on various factors important to e Learning. He identified the following factors that cover various online learning issues; pedagogical, technological, interface design, evaluation, management, resource support, ethical and institutional. These factors discussed in the eight dimensions of the framework can provide guidance in the design, development, delivery and evaluation of e Learning environments. Another useful framework is a model for developing an integrated e-learning culture in a large organization. [3]

The integration of e-learning is influenced by the various activities relating to e-learning. These are organizational priorities, learning environment, instructors' roles and learners' needs for developing an integrated e-learning culture in a large organization. All the four factors should be considered so that the extent of e-learning integration suits the organization that wants to embrace e-learning integration. This is important because different organizations have different priorities, different learning environments, different roles and different needs. In addition to the four factors of integrating e-learning, Newton and Ellis [4] suggest that the policy makers' views should also be considered. The above reviewed e-learning frameworks have been used to solve unique e-learning problems. Nevertheless, these frameworks do not address the issue of e learning integration with other teaching methods in its entirety. They mainly cover issues of e-learning systems development, application and adoption.

The framework for shifting e Learning systems onto Cloud has the potential to provide guidance in different aspects for e Learning, that will be used in the future as follows:

1. planning and designing e-learning materials,
2. organizing resources for e-learning environment,
3. designing distributed learning systems, corporate universities, virtual universities and cyberschools,
4. designing LMS, LCMS and comprehensive authoring systems (e.g., Omni),
5. evaluating e-learning courses, and programs.
6. evaluating e-learning authoring tools/systems, LMS and LCMS.
7. designing and evaluating blended learning environments
Cloud structure

Fig – 1. The base layer of e-learning cloud

The base layer of e-learning cloud shares IT infrastructure resources and connects the huge system pool together to provide services. Cloud Computing allows the hardware layer to run more like the internet, to make the hardware resources shared and accessed as data resources in secure and scalable way. Virtualization technology separates the physical hardware from operating system, which on one hand can make computing and storage capacity of the existing server into smaller size and re-integration, to improve the utilization and flexibility of IT resource; on the other hand can provide a common interface for large-scale cloud computing integration that enables the publication of calculation.

Enterprise Architecture based cloud

The use of the term “architecture” in this context comes, in part, from the idea that one can create a “blueprint” for how a business can run on technology. The “architect” is someone who looks at the materials available, interviews the “client” (aka the business) about desired form and functional outcomes, and engineers solutions to meet those needs.

As the corporation is a multi-“client” entity, the enterprise architect has been increasingly tasked with reconciling competing requirements to efficiently achieve form and function across the enterprise as a whole. To do this, enterprise architects were (and are) often granted control over large parts of how data, software and infrastructure are organized to efficiently address the greater good.
Enter cloud computing. is creating an environment in which software components and data collections intertwine to create a complex adaptive system. What this means is that “control” over the design parameters of enterprise computing is starting to be highly distributed among cloud infrastructure providers, service operators and those that build and run applications on those services.

In the end, the idea of “blueprinting” an ideal solution for an enterprise’s computing needs just doesn’t work. Things move to fast. People make decisions completely independent of what your business objectives are (or are perceived to be). There are entire data schemas, messaging formats, API definitions, and even entire business processes that an enterprise relies on that will be out of an “architect’s” control. But saying “there is no enterprise architecture” is a bit extreme, so let me temper that thought—slightly. There is no way to precisely specify the design, implementation and integration of complex cloud-based application systems. Therefore, the role of the enterprise architect is no longer building and maintaining a stable computing model for the enterprise. In the age of computing as a single, global, complex system, that role has to shift. So, enterprise product managers should focus on how to design environments in which their products thrive. The system as a whole must provide support for resilient component integration.

Enterprise Architecture is necessary regardless of changes to underlying technologies. If managed properly, Enterprise Architecture will iterate and adjust to the winds of change. SOA, as a technology development should be considered as standard, but Enterprise Architecture is at the heart of change. Cloud computing should have little impact on Enterprise Architecture.

It is the role of the Enterprise Architecture team to:

- Investigate if any style is simply hype or whether it holds real business value
- Understand the benefits and risks of a specific style
- Communicate these to Business and IT
- Develop an adequate governance framework
- Align the “style” with business requirements
- Give guidance for sustainable innovation

If Cloud computing does not take Enterprise Architecture into consideration, it will result in “spaghetti clouds” (aligned with “spaghetti architectures”).

Cloud computing is often characterized by: virtualized computing resources, seemingly limitless capacity and scalability, dynamic provisioning, multi-tenancy, self-service and pay-for-use pricing. Enterprise Architecture can help to make the shift to cloud computing smooth.

**Service Oriented Cloud Architecture**

The structured methodology for Service Architecture and Service Portfolio Planning is the underlying reference models have been contributed to various standards bodies and have been made available in the public domain. Today the core concepts are widely used by organizations moving to higher levels of SOA maturity where formality of reference model, policy and portfolio coordination are essential.[7]

The methodology is highly appropriate for the Service Oriented Cloud and has evolved to guide in areas such as:

- Decision criteria in use of the Cloud
- Cloud services classification
- Security and risk modeling for the cloud
- Policy development
- Cloud modeling considerations for all architecture views (business, specification, implementation) not just deployment

One can consider cloud computing the extension of SOA out to cloud-delivered resources, such as storage-as-a-service, data-as-a-service, platform-as-a-service , it is easy to get the idea and trick is to determine which services, information, and processes are good candidates to reside in the clouds, as well as which cloud services should be abstracted within the existing or emerging SOA.
The basic idea as an educational enterprise is not to rent a cloud service as per each college individually, still the enterprise architecture and its relevant standards as SOA will be highly needed as shown below the problem goes beyond renting best cloud, still the problem of the enterprise strategy, the policy and bylaws the control the internal operation and manage the job to job sequence, all of that can be given by applying the enterprise architecture as well as it major standards SOA.[8]

5. Comparative Analysis

The main objective of this research is to conduct a comprehensive comparison between e-Learning systems before and after moving on to Cloud. For this purpose, a variety of technical and research studies are reviewed to point out the prominent issues that can be solved by moving e-Learning System onto Cloud Computing environment. Our goal is to conclude how much the idea of moving e-Learning systems onto Cloud is significant? What are the benefits of shifting e-Learning systems onto Cloud and what are the discrepancies associates with e-Learning systems while running on the Cloud Computing environment? This comparison is shown in Table 1.

<table>
<thead>
<tr>
<th>E Learning Characteristics</th>
<th>Before Moving to Clouds</th>
<th>After Moving to Clouds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for Deployments</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>More Loss of control of any application or resources</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Conflicts between opposing goals of different clients, either play it together if not need to separate them</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Higher risks of Resource availability and failure</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Lack of trust in data alteration before storing</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Denial of Service attack in critical server health</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Higher risks of Stress, load and congestion</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Difficult to audit</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Monitoring of client logs and information by third party</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Need for Technical IT Support for Fail over</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need for Learning System Development Team</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need for extra hardware and software Resources and</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need to configure latest technology updates</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need to arrange own extra power and cooling</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Lack of computation and accuracy Trust</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Lack of confidentiality</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Lack of trust on security policies and access control</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Daily Storage and Backup burden</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Huge cost</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>High speed Internet connection</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Subscription and registration charges</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>Need for requirement gathering and Elicitation</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need for Project Management</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need for Coding</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>Need for Testing</td>
<td>√</td>
<td>×</td>
</tr>
</tbody>
</table>

Table 1: Comparison of e-Learning systems before and after moving on to Cloud.
As Table 1 shows, Cloud appears to be a promising future environment for e Learning systems and it offers several benefits, hiring new development and technical support teams is a quite budget consuming process. On the other hand, the subscription charges of getting services from cloud are too low as compared to the charges of hiring new teams. Similarly, the cost of hardware arrangement, extra power, cooling, and accommodation can be significantly reduced after moving e Learning onto Cloud.

According to a study – funded by MIT e Learning company – to prepare a study of 2 universities in the Arab countries using e Learning, the results show the benefits values of shifting e Learning systems onto Cloud, table 2 shows the results.

<table>
<thead>
<tr>
<th>Factors</th>
<th>% Reductions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement Elicitation and gathering cost</td>
<td>25%</td>
</tr>
<tr>
<td>Testing efforts</td>
<td>(20-10)%</td>
</tr>
<tr>
<td>IT labor and development team cost</td>
<td>40%</td>
</tr>
<tr>
<td>Capital Utilization Improvements</td>
<td>65%</td>
</tr>
<tr>
<td>Technical IT Support Cost</td>
<td>40%</td>
</tr>
<tr>
<td>Overall project cost</td>
<td>(35 – 40)%</td>
</tr>
</tbody>
</table>

Table 2: Cost reduction when moving e Learning onto Cloud

Adding to the cost reduction as a benefits, there were a technology and service operation benefits as follows:

**Technology Features**
- Client’s preferred Operating Systems
- Stable Virtual Machines
- Fully Redundant Architecture
- Web-Based Console
- Firewalls for security
- Compatibility support with already running applications
- Flexibility to cope new requirements.
- Technical service support (24/7) with guaranteed SLA

**Service Benefits**
- Enhanced cash flow: pay-per-use consumption ratio of desired model.
- Elasticity in new requirements and Flexibility in design
- Transparent services
- No limits for on demand resources
- Backup power control

6. Conclusion

As cloud computing provides a super-computing power that is extent beyond a single company or enterprise. In this paper, we investigated the issue of how Cloud Computing technology can be employed in e Learning systems in favor of higher education which have limited budget. We have conducted a comparative analysis for e Learning before and after moving to Cloud Computing environment. The investigation results confidently support moving e Learning onto Cloud Computing environment. Cloud-based e Learning as shown per table 2 can reduce development team cost, technical support team cost, testing effort, requirement elicitation, burden of daily backup management, and cost of overall project expenditure. We also analyzed the case of two big universities in Arab Countries with MIT as an IT services company in order to shed the light on how e Learning services are provided inside the universities. It was clear that the way the universities uses the Cloud to provide e Learning services is too expensive. Furthermore the results was reasonably feasible for MIT Company to
enhance the industry functionality and solution integration for more reduction of the cost, to make cloud a feasible for all universities levels.
References

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