

# Implementation of E-learning Architectures on Cloud in Academic Sector

Aberathne Siriwardane Thanuja Nishadi

<sup>1</sup> Faculty of Graduate Studies, University of Colombo

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**Abstract:** E-learning is one of the most promising pedagogy for education; however, most of the academic institutions are unable to facilitate full functional services using conventional e-learning systems due to various reasons. Cloud computing is widely adapted emerged technology used by many global institutions with facilitating for elastic consumption using virtualization, self-service and pay-as-usage by reducing most of the direct costs. The aim of the research was to ascertain the adoption of cloud based e-learning in private sector higher education institutions in Colombo, Sri Lanka. The conceptual model of the study was derived through the theoretical models of TOE, TAM and DOI. Then, there were four segments identified as technological context, organizational context, environmental context and user behavioral aspect. Further, the mixed methodology which consists of both quantitative and qualitative analysis was used in the levels of the users including learners, lecturers, higher management and technical people in each institute. Furthermore, there were 177 total respondents participated in the quantitative phase and 45 respondents participated in the qualitative phase. The statistical techniques of the Spearman's correlation and binary logistics regression analysis rendered F statistics and R2 values to test the predictive models. However, eight hypothesis identified as significant predictors and other eight hypotheses did not statistically predicate. Among the accepted significant indicators compatibility, bandwidth, top management support and motivation of academics were positively associated with the adoption and reliability, size, financial constraints and resource availability were negatively associated. Further, the challenges of implementing e-clouds have been identified in the qualitative phase.

**Keywords:** E-learning, global institutions, Academic Sector.

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## I. INTRODUCTION

Education is regarded as a one of the pillars of social development in modern era whereas global economy is shifted to knowledge based economy where knowledge is created, acquired, disseminated and utilized by all the parties due to greater socio economic development and global competitiveness. Most of the conventional education methods are not suitable for the social progress and not catering the digital age. The technology behind learning should be culturally acceptable; therefore, higher adaptability concerns with modern e-learning systems (Baroud & Abouchdid, 2010). Even though e-learning provides many benefits such as flexibility, diversity and measurement but issues are there in the implementation due to high initial cost, inadequate infrastructure, procurement of server/PC, storage, network and skilled staff (Masud & Huang, 2012; Jones, 2012). Cloud computing pedagogy reshapes the technology with absorbing the features of provisions of dynamically scalable and virtualized resources over the internet. Cloud can be considered as one of the alternatives to minimize the cost of infrastructure and human resources for development and maintenance process of e-learning systems (Chandran & Kempegowda, 2010). Therefore, the combined cloud based e-learning systems provide cost effective and efficient e-learning solutions.

The aim of the study was to ascertain the adoption of cloud based e-learning in private sector higher education institutions including sixteen (16) institutions approved by University Grant Commission (UGC) and Board of Investment (BOI) conducting affiliated degree programs with foreign universities and providing e-learning facilities in Colombo District. Further, the study covers mixed method approach which conduct in two phases; the phase I of the study covers quantitative analysis of data gathering and tested the hypothesis by using statistical tools of Cronbach's alpha, Spearman's rank-order correlation and binary logistic regression. The qualitative data gathering was conducted using interviews in the phase II. Further, it has identified the challenges of four sub areas including technological, organizational, environmental and also user behavioural aspects.

## II. LITERATURE REVIEW

### A. E-learning

E-learning plays a major role in the academic sector due to the rapid technological development of learning in time. Rosenberg (2001) defines e-learning as the application of internet technology for the delivery of solutions that improve knowledge and performance of individuals. According to Masud and Huang (2012) e-learning, is an internet-based learning process which aims to support conventional learning process that using internet technology and not replacing traditional education method. Ahmed (2010) defines the categories of e-learning as hybrid e-learning or pure e-learning, and synchronous e-learning or asynchronous e-learning. Further, the hybrid e-learning combined the features of 'teaching and learning delivered online along with teaching and learning delivered face-to-face in the classrooms'. In addition to that, pure e-learning categorized as teaching and learning offered solely online with no face-to-face learning. Similarly, hybrid e-learning defined as a mixed mode of e-learning or blended e-learning (Harasim, 2000; Bates, 2010). In synchronous e-learning, teaching and learning delivered online with the simultaneous online presence of instructors whereas asynchronous e-learning teaching and learning delivered online that does not require simultaneous online presence of the instructors and learners (Zhang and Nunamaker, 2003). Hence, the selection of e-learning to the organization is based on the requirement of it.

### B. Cloud Computing

Cloud computing has been considered as an emerged technology for hosting and delivering services over the internet. The National Institute of Standards and Technology (NIST, 2011) defines cloud computing as a type of model which enables convenient, on-demand network access to a shared pool of configurable computing resources which are rapidly provisioned and released with minimal management effort or service provider interaction. Similarly, European Network and Information Security Agency (ENISA, 2015) defines the concept cloud as, 'On-demand service model for IT provision, often based on virtualization and distributed computing technologies'. In addition to that, Federico (2011) states that using cloud computing allows organizations to rent computing power and storage and to pay on demand with gaining lot of economic benefits.

The Cloud provides different ontological views of what a cloud services are based on the industry requirements. NIST (2011) defines cloud service system is a set of elements that facilitating the development of cloud applications with classifying Software-as-a Service (SaaS), Platform-as-a-Service (PaaS) and also Infrastructure-as-a-Service (IaaS). SaaS is able to provide the consumer to use of the provider's applications running on a cloud infrastructure. Basically, applications are able to access through the various devices from client interface and also client does not manage or control the underlying cloud interface. In addition to that, PaaS provides consumer-created or acquired applications to deploying onto the cloud infrastructure and also use programming languages and tools provided by the provider.

### C. Cloud based e-learning

Many education institutions have been implementing e-learning systems on cloud in order to facilitate the huge growth of education contents and students. Sife, Lwoga and Sanga (2007) outline that installation of recent e-learning applications need large investments in infrastructure systems and dealing with concurrent requests. Due to the rapid growth rate of digital information, the traditional learning is becoming keep pace (Su, Tzeng & Hu, 2015). However, e-learning should facilitate configurable infrastructure that integrates learning materials, tools, and services into a single solution that creates and delivers training or educational content quickly, effectively, and economically. Therefore, cloud provides diversified solutions for e-learning users as per their requirements.

## III. RESEARCH QUESTIONS AND HYPOTHESIS

### A. Research Questions

The following research questions are formulated to realize the purpose of the research with regard to the adoption of Cloud Based E-learning Systems (CBES).

Q1: How is the usage of existing e-learning systems in private higher education institutions?

Q2: What are the technological, organizational, environmental and user behavioural influences?

Q3: How is the adoption of cloud based e-learning systems in private academic sector?

## B. Hypothesis

The research aims for the aspects of technology, organization, environment and user behaviours.

### Technological aspect

- H1: Security of cloud is associated with the adoption of cloud based e-learning
- H2: Compatibility of cloud is associated with the adoption of cloud based e-learning
- H3: Complexity of cloud is associated with the adoption of cloud based e-learning
- H4: Reliability is associated with the adoption of cloud based e-learning
- H5: Bandwidth is associated with the adoption of cloud based e-learning

### Organizational aspect

- H6: Institutional size is associated with the adoption of cloud based e-learning
- H7: Financial constraints are associated with the adoption of cloud based e-learning
- H8: Technology readiness is associated with the adoption of cloud based e-learning
- H9: Top management support is associated with the adoption of cloud based e-learning
- H10: Resource availability is associated with the adoption of cloud based e-learning

### Environmental aspect

- H11: Legal aspect is associated with the adoption of cloud based e-learning
- H12: Service provider support is associated with the adoption of cloud based e-learning
- H13: Relative advantage is associated with the adoption of cloud based e-learning

### User behaviours aspect

- H14: Adaption of learners is associated with the adoption of cloud based e-learning
- H15: Skills of IT management is associated with the adoption of cloud based e-learning
- H16: Motivation of academic is associated with the adoption of cloud based e-learning

## IV. CONCEPTUAL FRAMEWORK

Hypothesis of the research derived using three base models of Technology Organization Environment (TOE) framework, Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI) to formulate the conceptual model.

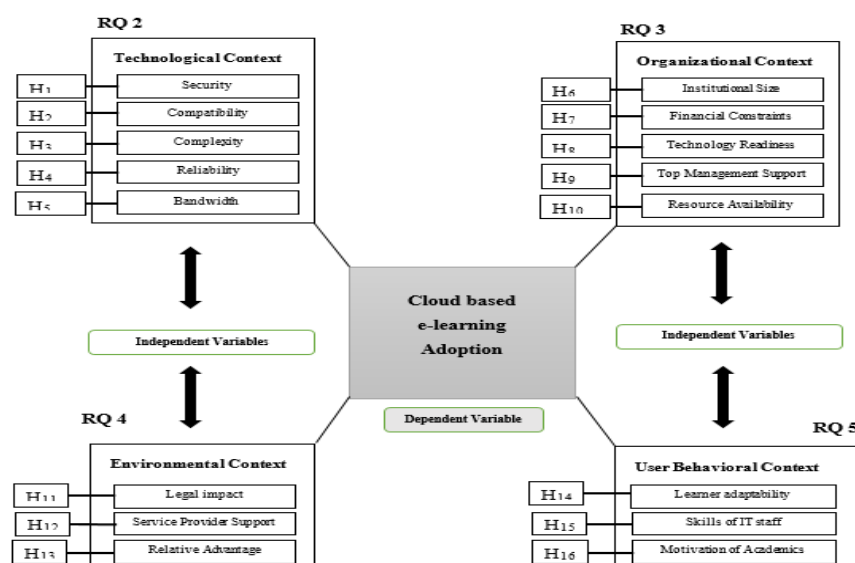


Figure I: Conceptual framework for adoption of cloud based e-learning

## V. METHODOLOGY

The study population consists of all the private sector academic institutions (UGC and BOI approved) in Colombo district which conduct affiliated degrees with foreign universities and providing e-learning facilities. However, it has been selected sixteen (6) institutions which approved by UGC in Sri Lanka, ten (10) institutions registered in BOI in Colombo district and three (3) institutions which representing both the categories. Further, the mixed method of research strategy including both quantitative and qualitative data adapted to meet the objectives in this study.

### A. Phase I: Quantitative Stage

Data collected from the sample respondents including learners, academic staff and key informants (IT Management and Managerial level) in each institution.

**Table I: Total respondents of quantitative phase**

Type	Learner	Academic	IT Management	Management	Total
Distributed	160	77	16	16	269
Received	88	60	16	13	177
Percentage %	55.0%	77.9%	100.0%	81.3%	65.8%

### B. Phase II: Qualitative Stage

The qualitative data collection had in two sub phases.

#### a. Investigation of key informants using qualitative methods

Respondents were selected from higher management and the representatives from technical specialist / IT management in each institution. The aims of this stage was to explore the views of both higher management and technical specialist in each institution about the usage of e-learning systems.

#### b. Investigation of academic people using qualitative method

Respondents selected from academic panel in each institution IT and Non-IT. The aim of this step was to evaluate the e-learning facilities provided by institutions and barriers for adapting.

**Table II: Total respondents of qualitative phase**

Sample Type	Element	Sampling Technique	Respondents	Technique
Key Informant (2)	Higher Management (1)	Non-Random/ purposively or Judgmentally by institute	13	45 interviews
	Technical Specialist(1)		16	
Academic	IT /Non-IT (1)		16	

## VI. FINDINGS

The quantitative findings of the study revealed that, 8 hypotheses were statistically significant and 8 hypotheses were not statistically significant.

**Table III: Variables**

No	variables	B	S.E.	Wald	df	Sig.	Exp(B)
H1	security	.087	.260	.112	1	.738	1.091
H2	compatibility	.683	.318	4.619	1	<b>.032</b>	1.981
H3	complexity	-.427	.257	2.762	1	.097	.653
H4	reliability	-1.526	.374	16.633	1	<b>.000</b>	.217
H5	bandwidth	1.042	.310	11.302	1	<b>.001</b>	2.836
H7	financial_constraints	-.853	.415	4.213	1	<b>.040</b>	.426
H8	Technology_Readiness	-.783	.451	3.006	1	.083	.457
H9	Top_management_support	1.527	.398	14.755	1	<b>.000</b>	4.605
H10	Resource_availability	-.959	.393	5.944	1	<b>.015</b>	.383

H12	service_provider	.423	.232	3.325	1	.068	1.527
H13	relative_advantage	-.558	.420	1.763	1	.184	.572
H14	adoption_of_learners	-.969	.561	2.982	1	.084	.379
H15	skills_of_ITstaff	.087	.312	.079	1	.779	1.091
H16	motivation_of_academicia	.972	.433	5.044	1	<b>.025</b>	2.644
H6	size	-.930	.308	9.130	1	<b>.003</b>	.394
H11	Legal_aspect	-.054	.130	.175	1	.676	.947
	Constant	2.977	1.563	3.625	1	.057	19.621

a. Variable(s) entered on step 1: security, compatibility, complexity, reliability, bandwidth, financial\_constraints, Technology\_Readiness, Top\_management\_support, Resource\_availability, service\_provider, relative\_advantage, adoption\_of\_learners, skills\_of\_ITstaff, motivation\_of\_academics, size, Legal\_aspect.

According to Table 1.1, the coefficients of compatibility, reliability, bandwidth, financial constraints, top management support, resource availability, motivation of academics and size are significant with p values of .032, .000, .001, .040, .000, .015, .025 and .003 respectively. The coefficient of compatibility of ( $p < 0.05$ ), reliability ( $p < 0.01$ ), bandwidth ( $p < 0.01$ ), financial constraints ( $p < 0.05$ ), top management support ( $p < 0.01$ ), resource availability ( $p < 0.05$ ), motivation of academics ( $p < 0.05$ ), size ( $p < 0.01$ ) were significant at the 0.05 level. Therefore, there are eight (8) hypothesis were statistically significant (H2, H4, H5, H6, H7, H9, H10, H16) other eight variables were not significant. The regression coefficient ( $\beta$ ) represents the positive or negative effect on the adoption of cloud based e-learning. Therefore, as per the findings,

- i. compatibility, bandwidth, top management support and motivation of academics were positively associated with the adoption of cloud based e-learning (which regression coefficient ( $\beta$ ) value (positive))
- ii. reliability, size, financial constraints and resource availability were negatively associated with the adoption of cloud based e-learning (which regression coefficient ( $\beta$ ) value (negative))

Further, the qualitative findings found that 50% of the total institutions in Colombo district already adapted with cloud based e-learning systems, whereas 6% of institutions in the sample are in the process of planning and also 43% of institutions are not currently using it; however, they are planning to move in the future. In addition to that, all the institutions in the sample offer any type of conventional LMS to their learners, including Blackboard, Moodle and portal etc. Furthermore, 56% of institutions currently use Moodle, 69% of institutions provide blackboard whereas 38% facilitate with student portals. Most of the institutions use internally done Moodle and also blackboard of their partner Universities. In addition to that, institutions provide e-learning facilities of e-library such as open source Koha library. Some of the institutions handle their internally built document management systems in order to provide users to upload their assessment and projects. Furthermore, all the users have separate login to access to the e-learning systems and able to access to course materials, upload and download assessments. In addition to that, lecturers are able to upload/download assignments and subject contents. It has revealed that users such as staff, IT management staff, coordinators, and administrative people in the institutions are granted accessibility. The findings indicated that, the most of institutions are received their login details from the partner university which they cannot customized. However, the basic information such as profile photos/ colour themes can be customized by the users. The findings reveal that most of the existing e-learning systems are highly secured. Moreover, the facilities of interactive learning are highly satisfied including 38% of the institutions provide forums to learners, 50% of institutions enabled online chatting facilities, nearly 20% of institutions facilitate with online help and 25% of higher education institutions provides virtual classrooms. There were no issues related to LMS reported from 31% of institutions; however, some of other owners indicated that, they do not have proper rights to handle the systems hence that is handled by the partner university.

It has been further identified challenges of implementing cloud based e-learning in the aspects of technological (security, bandwidth, compatibility, complexity, and reliability), organizational (cost, top management support, delaying decision making, resource availability and lack of skilled staff and lack of technical documents), environmental (competitor issues, service provider support and licensing issue) and user behavioural (inability to use at initial stage, generation gap and mind-set of some lecturers, resistant to change, lack of knowledge of lecturers, non-IT learners not familiar, lack of time of visiting lecturers to use and gain benefits, over use internet for unnecessary purposes, learners preference of classroom based learning than online learning, lack of resource persons, lack of recorded technical documents and leaving skilled IT staff).

## VII. CONCLUSION

Many global institutions have been hosting and delivering the contents using cloud based e-learning solutions in order to provide better solutions for users. Similarly, there is rapid growth in the Sri Lankan private sector higher education due to the increase of number of institutions, increasing number of learners opting for international qualifications and provide high qualitative service in collaborating with other countries. Therefore, it is highly required to provide qualitative service for their beneficiaries with the support of modern technologies. The study describes a comprehensive investigation of the adoption of cloud based e-learning systems in private sector higher education institutions in Colombo district. The study explored the types of the existing e-learning systems that they used and the usage of the e-learning systems, challenges of technological, organizational, environmental and user behaviours for adoption of cloud based e-learning systems. The 16 hypotheses which used in the study covered the aspects of technical, organizational, environmental and user behavioural and tested using binary logistic model. The findings of the study revealed that, 8 hypotheses were statistically significant and 8 hypotheses were not statistically significant.

## REFERENCES

- [1] Ahmed, H. (2010). Hybrid e-learning acceptance model: learner perceptions. *Decision Sciences Journal of Innovative Education*, 8(2), 313-346. <http://dx.doi.org/10.1111/j.1540-4609.2010.00259.x>
- [2] Bates, T. (2010). Understanding web 2.0 and its implications for e-learning. *Applying Social Informatics for Tertiary Teaching*. 21-42. Retrieved from <http://pscentre.org/images/extraimages/3%201013031.pdf> on 18<sup>th</sup> August 2015.
- [3] Baroud, F. and Abouchdid, k. (2010) E-LEARNING IN LEBANON: Patterns of E-learning Development in Lebanon's Mosaic Educational Context. In Demiray, U. (Editor) *e-learning practices: cases on challenges facing e-learning and national development, institutional studies and practices*, 409-424. Eskisehir-Turkey, Anadolu University. Retrieved from [files.eric.ed.gov/fulltext/ED508255.pdf](http://files.eric.ed.gov/fulltext/ED508255.pdf) on 18<sup>th</sup> August 2016.
- [4] Chandran, D., & Kempegowda, S. (2010). Hybrid e-learning platform based on cloud architecture model: a proposal. *International Conference on Signal and Image Processing*. <http://dx.doi.org/10.1109/icsip.2010.5697535>.
- [5] ENISA. (2015). Security Framework for Governmental Clouds. European Union Agency for Network and Information Security (ENISA), Retrieved from <https://www.enisa.europa.eu/.../cloud...cloud-security/security...clouds/> on 5<sup>th</sup> August 2015.
- [6] Federico, E. (2011). The Economics of Cloud Computing. *The IUP Journal of Managerial Economics*, 1(2), 1-5. Retrieved from <http://www.chinacloud.cn/upload/2012-05/12050307542670.pdf> on 15<sup>th</sup> August 2016
- [7] Harasim, L. (2000). Shift happens: online education as a new paradigm in learning. *The Internet and Higher Education*, 3(1-2), 41-61. [http://dx.doi.org/10.1016/s1096-7516\(00\)00032-4](http://dx.doi.org/10.1016/s1096-7516(00)00032-4)
- [8] Jones, M. T. (2012). Cloud computing and storage with OpenStack: Discover the benefits of using the open source OpenStack IaaS cloud platform. *Developer Works*, Retrieved from <http://www.ibm.com/developerworks/cloud/library/cl-openstack-cloud/> on 15<sup>th</sup> August 2016.
- [9] Masud, M.A.H., & Huang, X. (2012). An e-learning system architecture based on cloud Computing. *World Academy of Science, Engineering and Technology*, 62, 74-78. doi=10.1.1.221.4704
- [10] NIST. (2011). US Government Cloud Computing Technology Roadmap Volume II Release (Draft) Useful Information for Cloud Adopters. U.S. Department of Commerce. Retrieved from [http://www.nist.gov/itl/cloud/upload/SP\\_500\\_293\\_volumeII.pdf](http://www.nist.gov/itl/cloud/upload/SP_500_293_volumeII.pdf) on 5<sup>th</sup> September 2016
- [11] Rosenberg, M. (2001). E-learning: strategies for delivering knowledge in the digital age. *Educational Technology & Society*, 6(3), 80-81. Retrieved from [http://www.ifets.info/journals/6\\_3/11.html](http://www.ifets.info/journals/6_3/11.html) on 18<sup>th</sup> August 2015.

- [12] Sife, A.S., Lwoga, E.T., & Sanga, C. (2007). New technologies for teaching and learning: challenges for higher learning institutions in developing countries. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 3(2), 57-67. Retrieved from <http://ijedict.dec.uwi.edu/viewarticle.php?id=246> on 2<sup>nd</sup> August 2015.
- [13] Su, C., Tzeng, G., & Hu, S. (2015). Cloud e-learning service strategies for improving e-learning innovation performance in a fuzzy environment by using a new hybrid fuzzy multiple attribute decision-making model. *Interactive Learning Environments*, 1-24. <http://dx.doi.org/10.1080/10494820.2015.1057742>
- [14] Zhang, D., & Nunamaker, J. F. (2003). Powering e-learning in the new millennium: an overview of e-learning and enabling technology. *Information Systems Frontiers*, 5(2), 207-218. Retrieved from <http://link.springer.com/article/10.1023%2FA%3A1022609809036> on 18<sup>th</sup> August 2015