

CLOUD COMPUTING TECHNOLOGY SETUPS TO SUPPORT: THE LEARNING MANAGEMENT SYSTEM (LMS) IN HIGHER EDUCATION INSTITUTIONS IN OMAN

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ABSTRACT

The cloud computing terminology is used widely nowadays. Some people may not understand its technical meaning but they keep repeating this word every time an organisation is involved. The most crucial issue is to understand the in-depth meaning of the terminology, especially, for the decision makers in any company. Any misunderstanding would lead to wrong decision-making which can cost the organisation much time and resources. The internet is one of the most vital infrastructures needed to deploy this kind of technology which has become an important part of our lives. The author will explain in details the various types of Cloud computing services, such as; SaaS (Software as a Service), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service). This paper will discuss in detail the challenges and security issues that exist in the implementing of cloud computing service in most of the higher education institutions in Oman. In general, this paper will allow the organisations to choose where, when, and how they use cloud computing, and help the decision makers to play the right role in higher education institutions.

Keywords: Cloud-computing, Cloud-Security, Cloud-Challenges, Saas, PaaS, IaaS.

INTRODUCTION

Relevance of Cloud Computing in Higher Education

Just like business organisations are transforming by adopting cloud services, higher education institutions are also seeking a more effective way to implement their IT services without having to worry about the cost of either upgrades or maintenance. They want to adapt by being able to respond rapidly to new opportunities without taking long periods to implement a business-critical application (Katz & Educause, 2008). The higher institutions in Oman need to realise the full potential of their data systems in order to inform the strategic decisions of the future. Accordingly, there is no better way to achieve these unique needs than to adopt the cloud computing services.

Arias (2011) defines cloud computing as a computing paradigm where a large pool of systems are linked either in private or public networks, to offer dynamically scalable infrastructure for major purposes such as application, data and file storage. Similarly, cloud computing is a method of providing a set of shared computing resources including computing storage, networking, deployment platforms and business processes. It provides developers and IT departments with an opportunity to focus on what is critical in order to avoid undifferentiated work such as capacity planning and maintenance. It has become popular following different models and deployment strategies that have been developed to meet specific needs of various users. Therefore, every type of cloud service provides organisations with various levels of control, flexibility and management. The decision makers at higher education institutions in Oman stand to benefit from understanding the general aspects of cloud computing. The kind of cloud deployment that should be considered depends on Oman's particular performance, security requirements and the specific business goals. Proper application of cloud computing in higher education institutions in Oman will help to change the way they operate and serve constituents. Moreover, it will offer the institutions the ability to serve the educators, administrators and students who possess technology devices.

Deployment Models

The type of cloud computing to deploy differs depending on the requirements. The Learning Management System (LMS) in higher education institutions in Oman can be managed by either of the following deployment models, with each having its specific features that support the needs of services offered and the users involved with the clouds.

- **Public Cloud**-This cloud infrastructure can be accessed by the public on a commercial basis through a cloud service provider (CSP). As such, the consumers are able to develop and deploy services with less financial

outplay. The financial factor is attractive for higher education institutions as other deployment options are associated with higher capital expenditure requirements.

- Private Cloud-This cloud infrastructure is maintained as well as operated for a specific organisation. These operations could be in-house or under the management of a third party still within the premises.
- Community Cloud-This cloud infrastructure is shared among various organisations that have common interests. If the higher education institutions were to adopt this type of cloud computing, they would be able to limit their capital expenditure costs in establishing the service as the costs are shared among the institutions. Most probably, satellite campuses have the best chance of using cloud computing infrastructure.
- Hybrid Cloud-The hybrid cloud infrastructure hosts a number of clouds of every type.

However, these clouds allow data and applications to be moved from one cloud to the other through their interfaces. It can combine the public and private clouds that support the need to retain some data within an organisation.

SaaS (Software as a Service)

SaaS is the most common model of cloud-computing model. It is a software that is deployed over the internet in the 21st century. With SaaS, the providers license an application to their consumers as a service that is offered through a subscription in a “pay-as-you-go” model. It can also be offered absolutely free when there is a chance to generate revenue from other streams such as user list sales. With SaaS, the education institutions will not need to think of whether the service is maintained or even how the infrastructure is managed. Rather, the focus will be on how the software will be used. Consumers can access the various applications under SaaS through applications such as Google Docs, Gmail or through other devices such as iPads, laptops and smart phones. Unlike other software used before, the SaaS model does not need a license or an upgrade for it to work. Other advantages of this model include its configurability and multitenant efficiency (Chao, 2012).

With respect to its common features, SaaS is managed from a central location and the software is delivered in a “one to many” model. It requires web access to commercial software, and the users are not required to handle any of the software upgrades and patches. One of its major characteristic is that it allows for the integration between the different pieces of software since it is boosted by Application Programming Interfaces (APIs). Cloud computing, specifically SaaS, has evolved over the past few years as a popular technological method in different institutions. Having said that, the higher education institutions that are considering the move to adopt Cloud computing should decide which of the applications to move to. Some of the recommended candidates to be moved to SaaS include the tax software used on monthly basis. Other applications that have a significant need for mobile access should be moved alongside those applications that interlink the organisation and the outside world such as the email newsletter software. However, there are specific situations that SaaS should not be used for software delivery such as applications that require fast processing of real time data or where regulation does not allow the data to be handled externally.

Oman could currently be approaching SaaS with caution. Many of the higher education institutions in Oman rely on applications that have been built on legacy mainframe, ERP platforms, or other home-grown apps. These applications are often difficult to maintain and upgrade which is a venture that takes a toll on their budgets especially now that education institutions are trying to cut down costs. SaaS takes care of these technical and budget issues that have for long nudged the higher education institutions to move closer to the inevitable transition. Some of the universities who have shared their experience of having implemented SaaS have cited significant gains in efficiency, scalability and availability. SaaS can be accommodated by the higher education institutions with ease as it can host various applications, ranging from the horizontally significant tools such as customer relationship management (CRM) to the more vertically useful tools for specific tasks such as classroom scheduling and medical bills management. Furthermore, SaaS has already been proven to be popular across many industries including in higher education since the early 1990s. It has played a significant role in U.S. universities and colleges where students have been able to share ideas, and education infrastructure, resulting in reduction of the various institutions’ overhead expenditures. Some of the SaaS providers that could be helpful to the higher education institutions in Oman include the Zoho, Salesforce.com and the Google Apps.

PaaS (Platform as a Service)

PaaS is defined as a computing platform that enables the consumers to create web applications easily thereby foregoing the complex challenges involved in purchasing and maintaining the software and infrastructure within it. With PaaS, the cloud service providers provide, operate and maintain the system software and the computing resources. The consumer’s role is to manage and run the application software provided by the CSP. Besides giving the customers the chance to access ready to use applications, PaaS gives them the opportunity to design, develop and test the applications directly on the cloud. However, the consumers have to gain access to the platforms by

making a purchase to enable them to deploy their software and applications in the cloud computing platform. PaaS has an added advantage as it supports collaborative work between team members, making it suitable for multiple developers working on a common development project. PaaS is similar to IaaS in various ways, but it is unique due to its added value services. It is different from IaaS as it offers a collaborative platform for software development as well as a platform that allows software creation using proprietary data from an application. The major goal of the PaaS providers is to create an abstracted process that accommodates the deployment of high-quality applications that can be implemented either in public or private cloud models.

Despite its added advantages, the PaaS should not be used in cases where the applications require to be extremely portable with respect to where it is hosted. It is also not suitable where the proprietary approach would impact the development process or act as a hindrance to future moves to other providers.

IaaS (Infrastructure as a Service)

The IaaS contains the building blocks for cloud computing in IT. Just like the SaaS, IaaS is also developing at a fast rate to offer organisations an edge in terms of higher flexibility and management control over the IT resources. The IaaS delivers the Cloud Computing infrastructure such as servers, network and the operating systems as on-demand services. It is the most straightforward platform of the three models as it delivers computing resources in form of virtualised operating systems, hardware, software and storage services. It can be obtained either as a public or private infrastructure and/or both. The public cloud infrastructure is basically what consists of the shared resources that are provided on a self-service basis to the users over the internet. As for the private cloud infrastructure, virtualisation is practiced more in the form of the Cloud Computing features. According to Terplan (2011), some hosting providers are now offering a combination of traditional hosting along with public and private cloud networks. According to Sosinsky (2011), the consumer has the main responsibility of running and maintaining the operating system as well as the software applications on the virtual resources.

IaaS acts as a practical solution for institutions and organisations that want access to resources through an on-demand basis. It is also used to augment the data centre services. Through this function, the providers are able to increase capacity on demand, replace the worn out hardware with cloud-based services and offer a continuous access to sophisticated services. Just like the major aim of any service model in business is to enable the specific organisation to access an on-going support as the business changes, IaaS allows the organisations to experiment with modern innovative software approaches with minimal budget alterations. Some of the core characteristics that describe IaaS is that it allows for multiple users per a single piece of hardware. The IaaS allows for dynamic scaling as the resources are distributed as a service. It makes sense in several situations that are also closely linked to its major benefits. Some of the most appropriate situations that deserve to be enhanced by the IaaS include where there are variations in demand of the infrastructure. It is also appropriate for companies that have insufficient capital to invest in hardware (Korzeniowski, 2011). Some of the higher education institutions were inspired by this feature to adopt cloud computing. Even more appropriate is if the organisation is growing rapidly in such a way that scaling the hardware would pose a huge challenge. IaaS is also suitable where an institution has an increasing pressure to limit its capital expenditure and try to compensate that with a more efficient operating expenditure (Mahmood, 2011). Evidently, the higher education institutions need to compete while being able to minimise their costs and capital expenditure. Therefore, the best option is cloud computing. It appears to be a good inspiration to adopt cloud computing for the higher education institutions, but it is not recommended where its limitations could be a hindrance. Such situations include situations where regulatory standards make data outsourcing more difficult. It is also not applicable where a higher level of performance is expected, or the current infrastructure still has the ability to meet the stipulated needs efficiently. One of the most famous public infrastructures in IaaS includes the Amazon's Elastic Computing Cloud.

Important Features/Benefits that Cloud Computing could Offer to Higher Education Institutions situated in Oman

- Increased access to the limited IT expertise
- Decreasing capital expenditure and total costs of information technology in higher education institutions
- Enables the sourcing of either cycles or storage powered by renewable energy
- Scales IT services as well as resources
- Promotes additional IT standardisation
- Facilitates the direct match of IT costs, demand and funds
- Increases interoperability within previously disjoint technologies between institutions
- Enables universities to take advantage of the economies of scale they previously could not have achieved

- Free up more resources to support the core mission of the higher education institutions

Challenges and Security Issues Faced when Implementing the Cloud Computing Service

The challenges around implementing the cloud computing service within the higher education institutions in Oman relate to trust confidence and surety. Building an IT institution's confidence in a system requires a combination of consistency in performance, service guarantees, transparency and plans for contingencies McDonald (2010). In most instances, cloud services may not have the track-assured record on which one can build the needed trust to shift the existing services without a proven compelling benefit. These service attributes, unfortunately, come with time and experience. On top of these challenges, most IT organisations within the higher education institutions are usually not highly skilled in assessing and managing risk as well as service performance in 3rd parties. Other challenges may include poor and/or non-existent service level agreements, market immaturity and management issues (Leymann, 2011).

Some cloud-computing requirements are similar across all sectors. However, The Learning Management System (LMS) in higher education institutions face particularly challenging circumstances in several areas. Specifically, higher institutions in Oman may face the challenge of finding the right balance between private and public cloud. They must determine the right balance after considering all the security and legal issues and then pursuing change management strategies so that all the stakeholders can comprehend why the institution favours one application over another. Secondly, data privacy implications tend to be the major concern for higher education IT organisations. In the past decade, security has assumed an added dimension of complexity due to the development of bring-your-own-device programs in many education institutions (Catlett, 2013). As such, the Oman education institutions could find themselves being overwhelmed by the huge number of devices all requiring some form of on- college protection.

According to Rittinghouse & Ransome (2010), the magnitude of the involved risks is amplified by the burden of public trust associated with institutions that conduct research on human objects. What's more, the institutional culture acts as a real barrier to incorporating any of the above cloud computing models. Numerous research reports indicate that IT security and regulatory compliance also play a huge role in hindering the adoption of the cloud computing services being offered (May, 2011). IT experts in higher education institutions identify potential security breaches as the biggest barrier to adopting cloud computing models. There is a need to address the privacy issue that makes the above concerns real as they can be resolved through architecture. Unless the higher education institutions in Oman commit to study these issues, they may not be motivated to adopt the cloud computing services. Therefore, if the higher education institutions in Oman choose to adopt the cloud computing services, they could be faced with the following common risks associated with all cloud computing services in all industries:

- Lack of consumer isolation with the use of secure, scalable and multitenant services.
- Security which is not adequately focused during application.
- Failure to optimally exploit cost-saving initiatives such as disaster recovery during the cloud computing process.
- Insufficient virtualisation within the computing resources.

Whichever cloud computing strategy adopted by the Oman higher education institutions, it should always remain focused on firmly positioning education as the institutions' priority. In higher education institutions, the major objective of cloud computing does not have to be geared towards reducing the headcount in IT. Instead, the major objective is to give technology an opportunity to support the higher education institutions by providing education to the students.

CONCLUSION

The innovative higher education institutions of Oman seek to understand how and where to deploy the cloud computing models efficiently and securely in a manner that decision makers can play the right role. Their choices promise to transform the role of technology in their institutions. The higher education institutions in Oman need to keep up with various competing demands, such as delivering web-based services to students at a rapidly accelerating pace without any proportionate increase in budget for upgrading software, hardware and improved personnel. They also need to compete against the rest of the global higher institutions, the majority of which are adamant in differentiating themselves in the market with respect to the services they offer to their learners. Therefore, to support the transition, the higher education institutions must develop the most suitable cloud-computing strategy that addresses the problems and needs unique to every institution. The strategy has to have a risk-assessment framework in order to lead the practitioners through a risk-analysis of both premises and cloud-based delivery alternatives. Adopting cloud-computing services in higher education institutions has to be conducted cautiously as the unique models have different usage of resources. Since it is a relatively new adoption

in Oman, the higher education institutions that wish to transition have to maintain contact with the organisations that establish the industry standards in order to ensure there is a uniform and smooth transition.

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