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Article

Opportunity and challenges using the cloud computing in the case of Malaysian higher education institutions

The International Journal of Management Science and Information Technology (IJMSIT)

Provided in Cooperation with:

North American Institute of Science and Information Technology (NAISIT), Toronto

Suggested Citation: Shahzad, Arfan; Golamdin, Abd Ghani; Ismail, Noor Azizi (2016) : Opportunity and challenges using the cloud computing in the case of Malaysian higher education institutions, The International Journal of Management Science and Information Technology (IJMSIT), ISSN 1923-0273, NAISIT Publishers, Toronto, Iss. 20, pp. 1-18

This Version is available at: https://hdl.handle.net/10419/178822

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INTERNATIONAL JOURNAL OF

Management Science and Information Technology





The International Journal of Management Science and Information Technology (IJMSIT)

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The International Journal of Management Science and Information Technology (IJMSIT)

NAISIT Publishers

Issue 20 (Apr-Jun 2016)

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This is one paper of The International Journal of Management Science and Information Technology (IJMSIT) Issue 20 (Apr-Jun 2016)



Opportunity and Challenges using the Cloud Computing in the Case of Malaysian Higher Education Institutions

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Abstract: In this 21st century, the demand for cloud computing is increasing globally from all levels of industry including higher education institutions. In this study, we discuss the benefits and challenges involved in adopting cloud computing in the context of higher education institutions in Malaysia. It is expected that adopting the modern technology of cloud computing will reduce the cost of IT-based solution and services as well as of the ICT Infrastructure. Cloud computing enables rapid setup of ICT Infrastructure, more secure intra-organization connection and faster Web deployment. It provides greater opportunity for students and lecturers to build e-portal for sharing knowledge and learning tools. It will also help in an efficient and cost-effective manner, the internationalization of research projects. Many issues still remain to be addressed before cloud computing can be successfully implemented in the higher education sector. The importance of cloud computing will be outlined in this paper.

Keywords: Cloud computing, benefits, challenges, higher education institution, and IT

1. Introduction

Increasing access to the Internet, its widespread penetration, exponential increase in processing power and the growth of storage technology have led to an increase in the number of businesses that have migrated "to the cloud". Cloud computing can help in economic growth as well as in improving the quality of higher education. It can provide faster and more secure internetwork connection and can enable students and lecturers to achieve a faster way of sharing knowledge. Cloud computing technologies enable universities to set up websites, student portal, learning zone engine and Internet University research in a far more cost effective way than ever before. According to Ahmed and Al Nejam (2013), cloud computing has altered the information technology (IT) trends on desktop and portable PCs in the large data center environment. Businesses employ IT-based systems to collect, store, analyze and share data as well as documentation. Forrester, a leading market research, reported that in 2010, businesses and governments across the world spend USD 2.5 trillion on IT and communication technologies. Of that amount, USD 395 billion was spent on software, USD 344



billion was spent on hardware, USD 284 billion went to IT services and USD 238 billion went to IT outsourcing.

NIST defines cloud computing as, "Cloud computing is a model for enabling convenience, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interactions". Cloud computing refers to the delivery of IT resources over the Internet as services. This is opposed to hosting and operating these resources on pay-per-use or by monthly or yearly subscription (Shenai & Aramudhan, 2013).

Cloud computing has characteristics like virtual infrastructure, network access, scalability, flexibility, and management as well as metering that distinguish them from other common Internet services technology (Shenai & Aramudhan, 2013).

Figure 1. 0 shows the basic architecture of cloud computing.



Figure 1.0: Model Cloud Computing

Source: NIST (www.defenginc.com/solutions/cloud_computing)

The use of cloud computing in education is not a new phenomenon. Most developed countries like USA, Europe, and Japan are already using cloud computing technology in higher education institutions. Several government agencies have implemented ICT Infrastructure in order to achieve cost reduction. In the education sector, cloud computing has become insignificant to enrich teaching and learning process. Use of cloud technology encourages independent learning in the student community.

The use of technology in teaching and learning has enabled the widespread availability of knowledge. Learning systems can be adapted to meet the exacting requirements of students and can even provide opportunities for part-time students who do not have access to libraries. The objective of quality



education for all can be realized through the use of Information and Communication Technology. Cloud computing enables higher education institutions to become more competitive globally and provide world-class education as well as R&D opportunities to the students.

The strategic importance of cloud computing can be gauged by the fact that Google has introduced a cloud-based application (Google Educator) for teachers and g.doc (Google doc). Using this application, teachers and students can work freely in Microsoft Word, Excel and PowerPoint. Additionally, the users are spared the hassle of carrying discs and pen drives. Their data is stored in the "cloud" and is accessible on 24×7 basis.

Several cloud-based applications have been developed for the teacher and include Microsoft Office 365, iGoogle, Book Search, News, Google Notebook. There are several benefits that cloud computing can deliver to universities. According to McREA (2009), cloud computing contributes more towards improving teaching and research as compared to earlier and more complex IT and software systems. Another researcher Tout et al. (2009) concludes that cloud computing reduces the complexity of IT configuration.

Malaysian higher education institutions should set up a cloud computing infrastructure as this offers several advantages. These include a reduced cost of ICT infrastructure, improved communication among the higher institutions, easier sharing of data, upgrading individual libraries to an enterprise library system and integrating research related activity. It is also possible to set up a single education portal for Malaysia at a lower cost than if portals had been set up for individual universities.

In fact, the Malaysian government has taken the first step by implementing cloud computing for federal ministries and managed by MAMPU(Malaysian Administrative Modernisation and Management Planning Unit). There are 20 higher education institutions across. The government spends substantial sums of money to set up and maintain separate ICT infrastructure for each University. This study is based on cloud computing in higher education institution in Malaysia. The challenges and opportunities of cloud computing in the context of higher education institution will be explained in this study. Appendix 1, shows the number of universities, staff size and student enrollment in higher education institutions in Malaysia.

The usefulness of cloud computing in higher education has been recognized by many researchers. Sultan (2010) mentions the adoption of cloud computing by the University of California, and Washington State University's School of Electrical Engineering and Computer Science. He also mentions other institutions of higher education in the UK and Africa that have adopted cloud computing. This widespread adoption indicates the appreciation of cloud computing capability of enhancing learning system efficiency. Ethiopia as a developing country is spending vast amount of the budget to make the ICT Infrastructure for education. Higher Education Institutions (HEIS) are being built in very high speed. Currently in Ethiopia, there are around 31 government owned universities and many private colleges. The Ethiopian government has been investing millions of dollars every year in higher education institutions for technology. Yet, due to a struggling economy, it is not capable to supply full ICT infrastructure requirements of whole universities. Making the cloud for Ethiopian HEIs will give the benefits such as reduce the cost of ICT, resources can share with other universities (Saidhbi, 2012).. Although the demand for cloud computing is increasing from day to day, there are certain issues that cause concern. These relate to questions of trust, security and privacy.

The most significant of these issues is trust. Rousseau et al. (1998) describes trust as a psychological state comprising intention to accept and vulnerability and is based on positive expectations of the intentions or behavior of another. European citizens were surveyed in June 2011 regarding their trust in the protection of data on the Internet (European Commission, 2011). The 22% of the citizens



expressed trust in Internet companies such search engines, social networking sites and email services. The 70% of Europeans expressed the concern that their personal data could be misused.

2. Literature Review

The study of Saleh and Shahzad, (2013), claims that the new technology of cloud computing is a combination of virtualization, utility computing, elasticity, distributed computing, grid computing, storage, content outsourcing, security and web 2.0. There are several types of cloud computing characteristics, cloud different delivery models, and benefits. In the literature reviews, they define three different categories of cloud such as public, private and hybrid is the three core deployment model (Kuyoro, Ibikunle, and Awodele, 2011).

Armbrust et al (2009) postulate: "Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacentre hardware and software is what we call a Cloud." Borenstein and Blake (2011) colud computing defined as a "... the use of fast, high-bandwidth Internet connections to deploy services that are centrally maintained, often by third parties, and thus minimize the cost and difficulty of IT administration and support for the organizations that consume those services." Grandison et al (2010) explained that it as a "virtualization of qualified resources", with virtualization being "a method, process or system for providing services to multiple, independent logical entities that are abstractions of physical resources, such as storage, networking and computer cycles." IBM (2009) delimits it as "Cloud computing is an emerging approach to shared infrastructure in which large pools of systems are linked together to provide IT services." IBM's definition was included due to it being one of the most popular service provider of cloud computing to corporate sector. IBM Smart Cloud is providing all three paradigms (IaaS, PaaS, SaaS), the company also cooperates with universities and is a member of several groups.

Basically, there are four primary types of cloud deployment as mentioned by Rashmi, Sahoo, and Mehfuz (2013), such as public cloud, private cloud, hybrid cloud and community cloud. Meanwhile, based on Lee (2012) there are three types of cloud computing service software, first is an Infrastructure as a Service (IaaS). For examples the top providers of IaaS are Amazon (Elastic Compute Cloud), Rackspace, Joyent, GoGrid and Terremark. Second is Platform as a Service (PaaS). For instance the top providers for PaaS are Google App Engine, Microsoft (Azure Platform) and Force.com. Third is Software as a Service (SaaS). For instance the SaaS top providers are Google Apps, Salesforce.com and Zoho.com. In figure 2.0 shows the cloud deployment model.

One of the most famous cloud computing types is private cloud that is used to describe the offering on private networks. It is also known as internal cloud. A private cloud is exclusive design used by the specific organization and manages by the organization itself. Utilization on the private cloud can be more secure, reliable, and higher degree of control over performance compare to public cloud because its internal oriented where only stakeholders can access to operate all specific private clouds (Mohsin, 2012). Apart from that, public cloud is owned by the organization where resources are available for self-services basic via web application or web services on the internet. Moreover, the general public also uses a cloud computing environment. Public cloud is less secure than the other cloud model because it's lacking fine-grained control over data, network and security setting (Qi et al., 2010). Hybrid clouds provide virtual IT solutions through a mix of both private and public deployment models that combined together to provide a single common service which is included utilization hardware and virtualized cloud server. It's more secure than other cloud model because it



can control the data, application and grants various parties to access information over the internet (Kuyoro, 2011).

Figure 2.0: Cloud Deployment Model



2.1 Cloud Service Models

According to Shuaibu and Mohamad Fauzan, (2013), there are several types of service models of cloud computing services such as Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) as shown in table 1. Even though there are three models of cloud computing, it doesn't mean that all three models should be simultaneously implemented in the organization. The implementation is based on the specific needs of the organization.

Tal	ble	1:	Cloud	Computing	Service	Model	Providers
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SaaS Gmail, Google Doc, Finance, Collaboration, Communication, Business, CRM, ERP, HR Ex. Zoho, Salesforce, Google apps					
PaaS Web 2 application run time, Java 2 run time, Developer tools, Middleware Ex. Windows Azure, Aptana, Google apps engine					
laaS Servers, Storage, Processing power, Networking, Bandwidth Ex. Amazon web service. Dropbox. Akamai					

The cloud software as a service (SaaS) is where the vendor will provide, manages and also control the underlying cloud infrastructure which includes the individual applications, network, servers, storage and more. Example such Facebook, Twitter, Google Docs and more. Next is the cloud platform as a service (PaaS). This cloud is about where the vendors would provide and manage same



as SaaS except for the individual application where the customer has control over it. Tools and resources are provided to allow the customers to have an application that fulfills their needs. Last but not least is the cloud infrastructure as a service (IaaS). The vendors for this type of cloud provides, manages and controls cloud infrastructure but provides the customer control over the operating system, storage, processing and networks on demand too.

Based on different types of services model, the cloud computing can be primarily grouped into three layer model such as Software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS). SaaS is the top most layers which feature a complete application offered as services on demand. The SaaS vendor is responsible for developing and managing (data center spaces, operating system software, network access, server databases, power and cooling) and the processes (infrastructure and application upgrades, and backup). PaaS allows consumers to develop and deploy applications without software downloads or installations for developers, IT managers or end users. The users do not manage the infrastructure and allow clients to assume more responsibilities for managing the configuration and security. For example, PaaS includes Google App. Engine, Force. Com, and Microsoft Azure. IaaS refers to model previsions computing power, networking, and storage as virtual images to the consumers on demand basis. The main objective is to make resources (servers, network and storage) easier to access by applications and operating system. The clients normally pay on a per user basis, for example, Amazon Elastic Cloud Computing (EC2), and Amazon S3 (Firas & Amer, 2013). In figure 3.0 shows the service model of cloud computing.



Figure 3.: Service Model of Cloud Computing

(Sources: Qi, Cheng, & Boutaba, 2010)

There are several advantages using the cloud computing, mentioned by Mohsin (2012), such as reduced hardware and maintenance cost, accessibility around the globe, flexible and highly automated processes wherein the customer need not worry about mundane concerns like software up-gradation. Meanwhile, the data requirement of the client can be varied and it is important that the provided services can be scaled accordingly (Saleh, 2013). The use of cloud computing can make the task easier and improve efficiency of the organization, improve e-services delivery and will increase flexibility through the different deployment models that can align closely with organizational needs and ICT strategies (Saleh, 2013). Using cloud based applications; the organizations always get the best performance of their PCs because it can run faster through fewer programs in the computer's memory. Table 2.0 shows the most famous cloud service provider.

Service Provider	Service Name	Free Storage	Availability	Devices	Platform	Supported fie type and size	Other Features	
Dropbox	Dropbox	2 GB + extendable to 18GB through referrals	Everywhere	iPhone, iPad, Android, BlackBerry and any device with web browser	Windows, Mac, iOS, Linux	Any digital File (unlimited)	File versioning, auto sync, folder sharing, built-in audio player in web interface, off-line access through mobile apps, trash folder for deleted files	
Apple	iCloud	5 GB	Everywhere	PC, iPhone, iPad, iPod	iOS, Mac	Any digital File (unlimited)	Exclusive to iOS	
Amazon	Cloud Drive	5 GB	Everywhere except its Cloudplayer	All devices compatible with Adobe Flash	Windows, Linux, Mac	Any digital File (unlimited)	Cloud player music-streaming system is available only in US	
Microsoft's Windows Live service	SkyDrive	7 GB	Everywhere	iPhone, iPad, tablet, Any device with Browser,	Windows PC, Windows Phone, iOS, Mac	Any digital file (2GB Max Size)	Suite of web apps for creating and editing Word documents, PowerPoint presentations and Excel spreadsheets.	
Google	GoogleDrive	5 GB	Everywhere but Music Beta In US only	Any device with Browser, android device	iOS, Mac, Windows, Linux,	Any digital file (10 GB Max size)	1 GB free for Google Docs, 1 GB for Picasa, 7 GB for Gmail; Share and collaborate, 2- step verification, off-line access through mobile apps, trash folder for deleted files	

Table 2.0: Cloud Service Provider

Source: Arora & Gupta, 2012

Exposure to the technology and equipment related to cloud computing is an important application in order to provide education for students in line with industrial demand. Therefore, the university must take action to implement cloud computing in education. Through the cloud, information and knowledge can save more widely where the software and files are unnecessary or stored in a single machine. Therefore, the university needs to take advantage of emerging technologies to be implemented to enable students and staff to access information easily. Through cloud computing student and lecturer can access the information resources that are always available via a web browser (Fatimah, 2009).

Like other organization, universities also need services such as storage, email and financial transaction which require a cloud computing model, application, and service that can help the university fundamental activities such as teaching, research, and administration. In this technology century, many university's staff must convert to the cloud technologies in their personal life because it will convenience them to communicate and doing work in their educational environment (Forell,

Milojicic, and Talwar, 2011). Using cloud computing the administration system can get the application, database management, storage and other resources via network.

2.2 Cloud Educational Models

In the 21st century, educational establishments can efficiently work without modern informational technologies. At the same time support and development of the own IT-infrastructure is very expensive to maintain and needs to be updated time and again. Every year the level of the given expenses is growing more and more. The institutions are spending great amounts on technical and telecommunications equipment, software and hardware. One more important issue is that expenditures are required to support high professional level of the staff. This section will explain some cloud computing models for higher education insinuations.

A well-defined strategy is needed in order to migrate to cloud services. According to Sheelvant (2009), representing as an important part of an organization IT strategy, migration must be aligned to this. A migration to cloud can be formed by this strategy (see figure 4.0):

- (i) Developing the knowledge base about cloud computing
- (ii) Evaluating the present stage of the university
- (iii) Experimenting the cloud computing solutions
- (iv) Choosing the optimum solution
- (v) Implementation and management of the cloud computing solution

Figure 4.0: Cloud Strategy in Higher Education



In order to develop dynamic and interactive global team cooperation, the higher education institution can improve communication and collaboration with others through cloud computing technology. The university can achieve successful quality work through dynamic collaboration between the researchers with and academics. The application in the cloud computing, allowing the student and lectures easily share documents, conduct collaborative editing and manage the data effectively because it can do through a web browser, where the cloud will house the software and file (Fatimah,



2009). This situation indirectly can support the group work and give benefits to many learning situations.

This model is developed to collect and store the higher education institution researchers and academic works from many universities using public cloud services (SaaS and IaaS). Therefore, the cooperative universities of this model can store their own researches and retrieve the researches of other higher education universities in the same times. There are several advantages and characteristics provided by this model for higher education, such as, reduce the costs of researches retrieving and sharing, manage the large volume of research information efficiently and provide the researches in real time (Malik et al., 2012). Figure 5.0, illustrates the architecture and services of cooperative cloud computing model.





A federation model was recommended in order to bring the advantages of cloud computing assisted instructions into full play. The model showed how the higher education application model of software (SaaS), platform (PaaS), and infrastructure (IaaS) influences multiple independent clouds by creating a federation among the university private clouds and public clouds. A broker mechanism is suggested for better inter-cloud and inter-layer operation. In the education sector building more scalable education application based on the cloud computing will benefit the universities to improve the communication among the researchers, students and faculty members (Donlin et al., 2012). Silicon Cloud International (SCI) is a privately held company, incorporated in Singapore. SCI is providing the secure and private cloud-based semiconductor nationwide design infrastructure and eco-system. The SCI main focus is to provide "National IC Design Clouds" for universities and research Institutions, across the globe with the military-grade security standard (SCI, 2013). Silicon cloud international business model in figure 6.0 shown that solution focuses upon providing to its customers a broad range of tested, proven integrated circuit design workflows, that are securely



provisioned through SCI's private cloud computing OpenStack enterprise architecture. Using a thin client, cloud access appliance, users are authenticated into the SCI Cloud using 2-factor authentication through an SSL VPN connection. The SCI browser-based dashboards will allow the user to securely navigate customized workflows, semiconductor IP from EDA ISVs, silicon foundries, and 3rd party IP suppliers.

Figure 6.0 Model of SCI IC Design for Universities & Research Centers



3. DISCUSSIONS

3.1 OPPORTUNITIES OF CLOUD COMPUTING IN HIGHER EDUCATION INSTITUTION

Every year the Government allocates about 20 percent of the Federal budget for education purposes. Malaysian Prime Minister Dato' Seri Haji Mohd Najib bin Tun Haji Abdul Razak announced in Budget 2014 that the allocation of 54RM billion for the Ministry of Education. The allocation of budget for education figure showed that the Government assigned considerable importance to the development of human capital in the country. In fact, spending on education in Malaysia is higher than the Organization for Economic Co-operation and Development (OECD) average (3.4%). Education in Malaysia is an ongoing effort in fostering the potential of individuals in a holistic and integrated approach to create balanced and harmonious individuals who are intellectually, spiritually, emotionally and physically sound. In order to achieve these goals, Malaysian government provides a huge amount to cultivate the quality of systematic education through the cloud computing. Cloud computing will provide the opportunities for higher education institution innovation and a political program to turn IT into more effective and responsive management service. Many researchers pointed that cloud computing will flourish in education sector more quickly in the higher education



sector (Kalim, 2013; Senai & Aramudhan, 2013; Mohsin, 2012; Qi, 2010). It will help the higher institution in terms of cost reduction, information sharing, widespread accessibility, unlimited storage space, easier collaboration group management system and easy to manage the infrastructure.

Higher education institutions will achieve a reduction in the cost of implementing cloud computing. In fact, one of the advantages of cloud computing in the gains attained by reducing cost (*Arora & Gupta, 2012*; Qi, 2010). Cloud computing can increase the use of technology and resources, in which physical equipment is not required and a lower price can be obtained. The management in higher education does not have to invest in hardware or servers, applications, or to train their employees to manage servers or to pay for the purchase or maintenance of the software. Sharing information is essential to facilitate cloud computing infrastructure. In cloud computing infrastructure, the Ministry of Higher Education can easily and quickly manage all information related to the universities such as the numbers of student among universities (local and international), the amount of graduate student (local and international), the number of lecturers (local and international) and all related information (Gourmet Singh, 2012). Using the Cloud computing services the Ministry of Higher Education can easily the resources for higher institutions (Qi, 2010). For instance, the Ministry of Higher Education can know the requirements of each university so that they can take action directly. In figure 7.0 and table 3.0 shows the higher education cloud.

Figure 7.0 Model of Malaysian Higher Education Cloud



Malaysian Higher Education Cloud

Table 3.0 Malaysian higher education cloud Model

Malaysian education institutions	Application/system	Cloud Computing Benefits			
The 20 Malaysian higher education institutions will access the education cloud services Universiti Malaya (UM) Universiti Kebangsaan Malaysia (UKM) Universiti Teknologi Malaysia (UTM) Universiti Teknologi Malaysia (UTM) Universiti Malaysia Sarawak (UNIMAS) Universiti Malaysia Sarawak (UNIMAS) Universiti Malaysia Sarawak (UNIMAS) Universiti Malaysia Sabah (UMS) Universiti Pendidikan Sultan Idris (UPSI) Universiti Sains Islam Malaysia(USIM) Universiti Teknologi MARA (UiTM) Universiti Teknologi MARA (UITM) Universiti Teknologi MARA (UITM) Universiti Malaysia Terengganu (UMT) Universiti Tun Hussein Onn Malaysia(UT) Universiti Teknikal Malaysia Melaka (UT) Universiti Pertahanan Nasional Malaysia (UPNM) and other higher education Institutions	 Integrated Library system E-portal (Studentsystem, administration, academic system and examination system) Finance system Alumni system Alumni system Research system Email system Web sites Survey and evaluation Human Resource System Recruitment system 	 (SaaS, PaaS and LaaS) Share information and service of different universities to reduce services and infrastructure costs and manage universities activities securely and efficiently Share the researches and academic works between the universities from many counties. Manage the large volume of data and information on different university department or campuses efficiently to retrieve the necessary information in real time. Disaster Recovery system Big Data management Cockpit for management Green ICT environment Availability 24 by 7 			

Using cloud computing, they can create a collaborative group more easily. It allows them to upload files or documents and gives the ability of sharing PCs to PCs, audio and video that can be shared with an unlimited number of users. They can discuss and have collaborated (Arora, 2012) about certain subjects. For example, in the Northern University of Malaysia or UUM, cloud computing can provide e-learning or Learning Zone, which can be accessed by thousands of students simultaneously.

Storage space allows them to share whichever website can serve hundreds of thousands user and upload their documents or files to be shared with other users. Applications of cloud computing can be used as a platform for the lecturers and students to share data while it is to complete a task without having to face each other and interact at the same time. Students or lecturers can save as much data or information on storage space. One of the examples of storage space is Dropbox. Dropbox is a storage service that uses cloud computing technology. It can be accessed via mobile, computer, or a tablet. This storage allows accessing the documents anytime and anywhere.



The management system and ease of use also become one of the opportunities using cloud computing for higher institutions. It will help to facilitate the students, lecturers and staff to store data on the cloud. Use of cloud computing will provide services to students that are more systematic and available 24/7. Saleh (2013) claims that cloud computing applications and information are hosted online therefore it has high availability and citizens can use them any time and from anywhere. The benefits that the Malaysian higher education system will draw after implementing cloud computing are listed below:

- 1. **Reduced spending on technology infrastructure in higher education institutions**. Maintain easy access to information with minimal upfront spending. Higher education institution's expenditure will be based on usage.
- 2. Globalize workforce on the cheap. Using cloud computing, nationwide educational network can be set up.
- 3. Streamline processes. Tasks can be performed with efficiently with the less man power.
- 4. **Reduced capital costs**. There's no need to spend huge amount of money on hardware, software or licensing fees separately by each higher education institution.
- 5. **Improved networking among the higher institutions**. Higher institutions can access anytime, anywhere 24 by 7 information.
- 6. Less personnel training is needed. It takes fewer people to do more work on a cloud, with a minimal learning curve on hardware and software issues.
- 7. **Minimize licensing new software**. Stretch and grow without the need to buy expensive software licenses or programs. For example the library services can be built nationwide, Learning Protals, Research activities and other services.
- 8. **Building the education bridge.** Implementing the cloud computing in higher education to build the information bridges among the higher education institutions.
- 9. **Disaster recovery Centre.** Only one Disaster recovery center will build for 20 Malaysian higher education institutions to reduce costs.

3.2 CHALLENGES OF CLOUD COMPUTING IN HIGHER EDUCATION

Cloud computing can play an essential role in the success of a higher education system. However, it is difficult to adopt cloud computing storage. Even though it has been utilized widely and can benefit tertiary education system, there are several challenges that must be overcome to enable cloud computing system to be implemented effectively. The challenges of cloud computing relate to management, technical, security, and service.

As a developing country, Malaysia is still at the process of increasing efficiency and speed of Internet access in rural areas. The continued weakness of the system is causing difficulties for the country in the way of adopting a cloud computing system widely in the management of higher education. This is because the use of cloud computing requires reliable high-speed access to the Internet. Without an Internet connection, data cannot be stored or quickly accessed.

Lack of cloud computing expertise in Malaysia has directly complicated its implementation as a new technology. This is a challenge that prevents its use in higher education institutions. They are advised to obtain consultancy from businesses that posses the expertise and experience. Local technologists should be given training and guidance on the use of cloud computing so that data can be handled efficiently without errors.



Privacy and security are major challenges for higher education institutions in adopting cloud computing. This is because privacy issues and the protection of information, especially when they switch to cloud computing are issues of importance. The higher education information process sensitive data and personal information of students. The main challenge in this category is security of confidential data. Owners of data that is stored and processed on servers owned by a third party are fully their responsible for it (Saleh, 2013). Higher institutions cannot control and do not know where the data is being stored. This situation can lead to data leakage resulting in loss of trust by citizen and public organization. Corporate data can be stolen from a cloud by a determined cyber attack.

4. CONCLUSION

Cloud computing becomes a hot subject and it is seen as the next generation architecture of IT enterprise. In the forthcoming years, it is anticipated that the cloud will dominate the IT market. Cloud computing provides tangible benefits to higher education institutions that seek a global ranking in education. Cloud computing encounters challenges in higher education that include lack of expertise, security and privacy, and speed of internet in Malaysian rural areas. However, cloud computing has the potential to become secure, practical and economically viable IT solution in the future through cost saving, sharing information, easy to access, storage place, and easy operational in management system in higher education institutions. Many such institutions that carry out cloud computing believe in its promise of higher accessibility, and efficiency. These will encourage universities to apply cloud based services. Kalim (2013) proves that, Today's cloud computing providers offers higher education the opportunity to substitute a presence in "the cloud" for universities existing data centers, servers, and applications replacing these machines traditional physical presence on campus. This study suggests researchers to investigate the possibility of making the role of data centers in institutes of higher education more dynamic.

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Appendix

Appendix 1



	LOGO	NAME	YEAR	LECTURES		STUDENTS
				М	F	-
1	Saint Saint	Universiti Malaya (UM) Lembah Pantai, 50603 Kuala Lumpur http://www.um.edu.my	1961	553	579	24132
2		Universiti Sains Malaysia (USM) 11800 Minden,Pulau Pinang http://www.usm.my	1969	584	521	24531
3		Universiti Kebangsaan Malaysia (UKM) 43600 Bangi, Selangor http://www.ukm.my	1970	565	733	22722
4		Universiti Putra Malaysia (UPM) 43400 Serdang,Selangor http://www.upm.edu.my	1971	382	497	26178
5		Universiti Teknologi Malaysia (UTM) 81310 Skudai, Johor http://www.utm.my	1975	683	513	28683
6		Universiti Islam Antarabangsa Malaysia (UIAM) Jalan Gombak, 53100 Gombak, Selangor http://www.iiu.edu.my	1983	448	460	24537
7		Universiti Utara Malaysia (UUM) 06010 UUM Sintok Kedah http://www.uum.edu.my	1984	434	485	34416
8	AVAILAND NOT AND	Universiti Malaysia Sarawak (UNIMAS) Kota Samarahan, 93400 Kuching, Sarawak http://www.unimas.my	1992	215	253	8057
9		Universiti Malaysia Sabah (UMS) Beg Berkunci 2073, 88899 Kota Kinabalu, Sabah http://www.ums.edu.my	1994	305	289	13096
10		Universiti Pendidikan Sultan Idris (UPSI) Jalan Slim, 35900 Tanjung Malim, Perak http://www.upsi.edu.my	1997	246	208	13445
11		Universiti Sains Islam Malaysia(USIM) Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan http://www.usim.edu.my	1998	143	166	6293
12		Universiti Teknologi MARA (UiTM) 40450 Shah Alam, Selangor http://www.uitm.edu.my	1999	2490	4528	167108
13	Leveler jest	Universiti Malaysia Terengganu (UMT) 21030 Mengabang Telipot,Kuala Terengganu,Terengganu <u>http://www.umt.edu.2000my</u>	1999	130	156	6814



14		Universiti Tun Hussein Onn Malaysia(UTHM) Beg Berkunci 101, 86400 Parit Raja, Batu Pahat, Johor http://www.uthm.edu.my	2000	314	223	9379
15		Universiti Teknikal Malaysia Melaka (UTeM) Hang Tuah Jaya 76100 Durian Tunggal, Melaka.http://www.utem.edu.my	2000	314	208	7335
16	Ũ	Universiti Malaysia Pahang (UMP) Beg Berkunci 12, Kuantan, 25500 Pahang http://www.ump.edu.my	2001	241	184	6513
17	W MAP	Universiti Malaysia Perlis (UniMAP) Tkt. 11, Bangunan KWSP,Jalan Bukit Lagi, 01000 Kangar, Perlis http://www.unimap.edu.my	2001	235	173	6023
18		Universiti Sultan Zainal Abidin (Dahulu dikenali sebagai UDM) Canseleri Kampus Kota Jalan Sultan Mahmud Kuala Terengganu 20400 Terengganu <u>http://www.unisza.edu.my</u>	2005	152	154	5251
19		Universiti Malaysia Kelantan (UMK) Karung Berkunci 36, Pengkalan Chepa, 16100 Kelantan http://www.umk.edu.my	2006	50	51	1882
20		Universiti Pertahanan Nasional Malaysia (UPNM) Universiti Pertahanan Nasional Malaysia Kem Sungai Besi 57000 Kuala Lumpur http://www.upnm.edu.my/	2006	76	64	2121