A study on Cloud Computing issues and challenges in higher education institutes of Middle Eastern countries

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Abstract: The demand of cloud computing has been increasing in all kinds of IT industry. Cloud computing has a lot of benefits and hence it is necessary to make full use of it in order to be competitive globally. In this study we find out the issues and challenges that we face while applying cloud computing to higher education institutes in Middle East. The issues vary from security to technological readiness of an organization and also discusses the lack of standardization in the Cloud Computing. Some study is also done on the application of cloud computing in other educational institutes around the world and how they tackled the issues to achieve successful cloud adoption. The major issues that need to be addressed before using cloud computing in higher education institutes in Middle East will be outlined in this paper.

IndexTerms–**Cloud computing, issues, challenges, higher education institutes, Middle East**
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I. INTRODUCTION

Cloud Computing enables users to acquire computing services and resources as per there requirement without the need to purchase an infrastructure of their own, the users of the services only pay for they are using (Kogias, Xevgenis and Patrikakis, 2016). Cloud computing is modelled to be seen everywhere or defined as ubiquitous. This makes it convenient for all the involved parties which can demand network access as per there requirement to configurable computing resources. These computing resources can include networks, applications, data-storage, servers and various services. The resources can be provided with very low service provider interaction and hence requiring very less management effort (Mell and Grance, 2011). Cloud computing relates to both the hardware and software that provide services and also the application that are delivered to an organization as a service (Armbrust et al., 2010).

Importance of cloud computing is due to its potentials that include the transformation of the Information Technology industry and also the ability to reshape how IT hardware is purchased depending on the designs an organization requires. It decrease the required capital to implement innovative ideas which otherwise required a lot of capital to setup the hardware environment for pursuing such ideas (Armbrust et al., 2010). The essence of cloud computing lies in the concept of Virtualization. Virtualization technology is not a recent find but dates back to 1967, however this was only available on mainframe computers for a number of years. Virtualization can be refined as, a computer hosting service that runs the application and it is called hypervisor, this process creates virtual machines generally more than one, this simulates our physical computers so seamlessly that they are able to run any kind of software from our operating systems to the end user applications (Zissis and Lekkas, 2012).

The most popular cloud computing sharing services includes Dropbox and Google Drive. The implementation of cloud computing cannot be only limited to business fields but also mapped onto other famous internet markets. The exponential rise of e-learning organizations and internet based learning makes it important for us to tackle the challenges and issues in those field with the application of cloud computing. This will help us to make these markets more efficient and effective in the way that they operate (Shana and Abulibdeh, 2017). The efficiency and effectiveness will not only help the organizations to make their process easy but it will help all the potential customers to operate swiftly and be more mobile. 24 Hour access is a major benefit to all the parties involved, the functional capabilities can reach new heights and it is a green technology which is very important for the current environment situation (Ghazizadeh, 2012).

Cloud computing in education has become essential for all the three major involved parties that are students, teachers and the university itself. Cloud computing is being adopted by many educational institutes all around the world, it comes as no surprise due to the number of benefits it give us such as, instant file sharing, collaborating with various systems and the provision of online education, it also lets us use various services which may include educational services, offering software of all types and various other resources (Bouyer and Arasteh, 2014).

II. CHARACTERISTICS OF CLOUD COMPUTING

There are five essential characteristics of cloud computing. On-demand self-service means that the customer can acquire services individually, it may include server time or network storage as per their requirement. This process can be done without the involvement of human interaction with the service provider. Broad network access can be defined as the accessing of networks through standard procedures that promote the use by diverse client platforms. Resource pooling can be defined as the provision of services by a same cloud service provider to more than one customer with flexible resources provided to each customer based on their own requirements. Rapid Elasticity can be defined as providing and scaling infrastructure as the demand increases or decreases. Measured service is the automatic control and optimization of the resources by metering down the capabilities which is directly related to the type of service provided (Branco, De Sá-Soares and Rivero, 2017).

III. TYPES OF CLOUD COMPUTING SERVICES

Cloud services can be divided into three categories which include SAAS-Software as a Service, IAAS-Infrastructure as a Service and PAAS-Platform as a Service. The services that an organization chooses is purely based on their own requirements (Usman and Noordin, 2013).
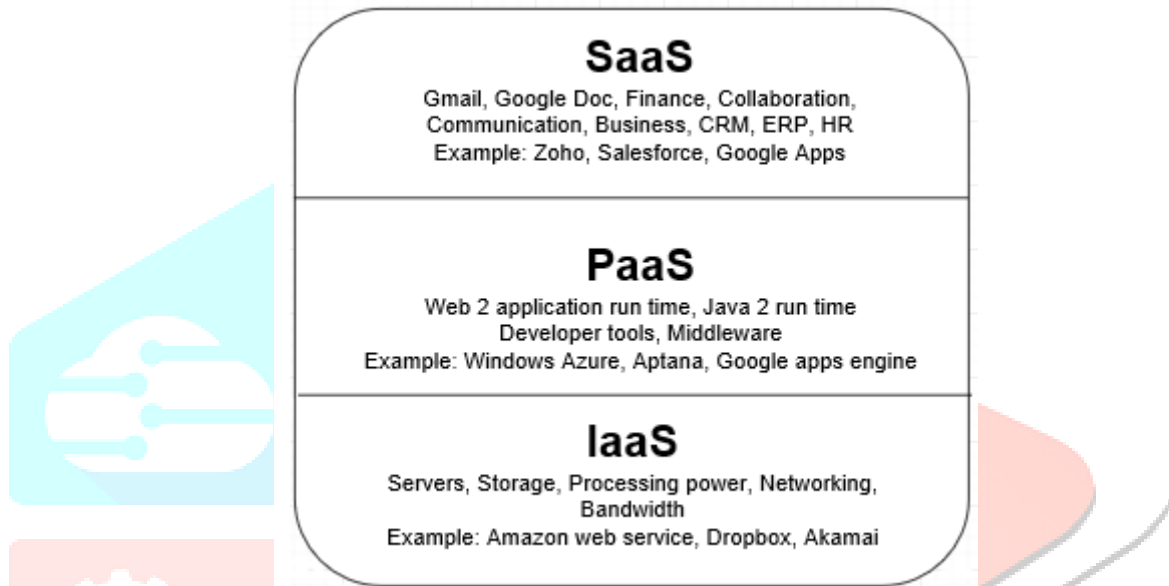

SaaS
Gmail, Google Doc, Finance, Collaboration, Communication, Business, CRM, ERP, HR
Example: Zoho, Salesforce, Google Apps

PaaS
Web 2 application run time, Java 2 run time
Developer tools, Middleware
Example: Windows Azure, Aptana, Google apps engine

IaaS
Servers, Storage, Processing power, Networking, Bandwidth
Example: Amazon web service, Dropbox, Akamai

Figure 1: Types of Cloud Computing Services (Shahzad *et al.*, 2016)

a. Software as a service

In this model a service is acquired from a provider based on the demand of the customer. It is the duty of the vendor to manage the infrastructure of the cloud which may include operating systems, data storage servers, applications, networks etc (Usman and Noordin, 2013). This service eliminates the need of installing applications on customer's devices (Al Morsy, Grundy and Müller, 2010). The customer can access the application as agreed upon by the provider initially. The customer is not limited to use this service for a particular device but has the ability to access it from any type of device. Some famous SaaS providers include Salesforce.com, Google Docs, Facebook, Twitter (Usman and Noordin, 2013).

b. Platform as a service

In this type of service the vendor has to manage and control cloud infrastructure for the applications that the customer has paid for. The job of the vendor is to provide the tools required and the resources needed to the customers to create their own applications (Usman and Noordin, 2013) & (Kapil et al., 2017). Famous examples of PaaS can be Windows Azzure and Google Apps Engine.

c. Infrastructure as a service

In this type of service the vendors job is to provide the management and control of the cloud infrastructure but also enables the customer to control the operating systems, processing, data storage and networks as demanded (Usman and Noordin, 2013). This service is a combination of providing hardware, hosting and the basic services that are required to run a cloud (Manvi and Krishna Shyam, 2014). Some famous IaaS service providers can be Amazon Web service, Flexscale and Dropbox.
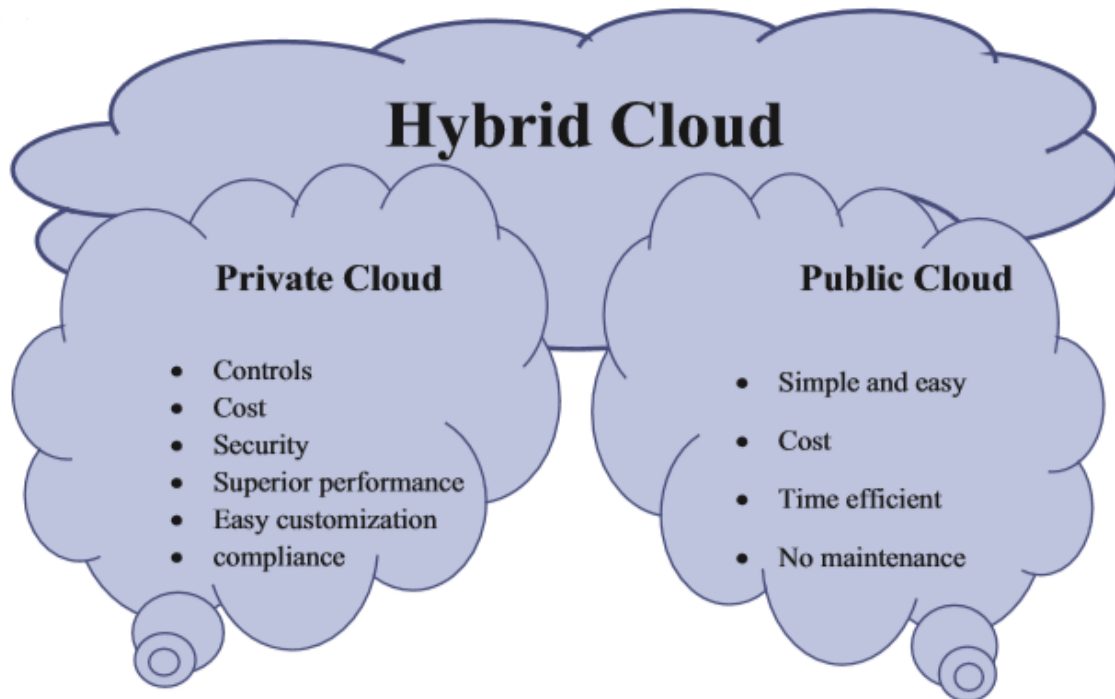
IV. CLOUD DEPLOYMENT MODELS

Figure 2: Cloud deployment models (Uddin, Lie and Li, 2017).

a.   Public cloud

Public cloud is built and designed to share, it includes the sharing of data centers infrastructure related to software and hardware. It can be shared by a number of different organizations (Uddin, Lie and Li, 2017). The infrastructure is the property of Cloud Service Provider, it will exist on the location of the provider. All types of customer which may include, general public or huge industry groups, can access services for usage as per their requirement. Resources are allocated to customer on-Demand. Small and medium enterprises usually take the most advantage by using public clouds. Benefits of public cloud includes cost saving, flexibility, reliability, mobility and high scalability. Security however is a problem (Rani, Rani and Babu, 2015).

b.   Private cloud

Private cloud is a cloud infrastructure dedicated to a single organization (Uddin, Lie and Li, 2017) & (Ashtari and Eydgahi, 2015). Security issues can be solved by using a private cloud infrastructure and that is the main reason for using Private cloud (Ashtari and Eydgahi, 2015).

c.   Community cloud

Sharing of infrastructure between more than one organizations is defined as Community cloud (Uddin, Lie and Li, 2017)&(Arunkumar and Anbuselvi, 2017). Organizations that share the same concerns such as mission, compliance considerations, security requirements and policies use a community cloud. This infrastructure may be managed and operated by a third party, the organizations itself or maybe a combination of both (Uddin, Lie and Li, 2017). The major benefit of using community cloud is to achieve the advantages of a public cloud but with an added level of privacy that is associated with private clouds (Arunkumar and Anbuselvi, 2017).

d.   Hybrid cloud

Hybrid cloud can be defined as an infrastructure which is a combination of more than one cloud infrastructures (Uddin, Lie and Li, 2017). The combination helps us eliminate the limitations that are present on each infrastructure and to take advantage of benefits that each infrastructure offers. In general, hybrid clouds result in more range and flexibility as compared to its predecessor's public or private cloud infrastructures (Ashtari and Eydgahi, 2015).

V. ISSUES AND CHALLENGES IN CLOUD COMPUTING

a. Data storage and computing security

Storage of data is an important part of cloud computing. The data stored in cloud computing is isolated and customers are worried to provide such data out of fear of losing it in mysterious hands to avoid unfavorable consequences. The challenge is to keep their data consistent and confidential but it is easier said than done because the data is stored on the third party server which the customer has no knowledge of (Singh and Chatterjee, 2017).

b. Internet and services security

Cloud services requires a carrier to communicate in order to use the services at offer. Internet is a medium of communication to transfer data from one source to another. The data travels from one point to another which is really not safe. There are many threats while the data is being moved from one place to another via the internet. The problems may include IP Spoofing, malware injections, packet sniffing and port scanning. Some issues do have solutions but it is still a challenge to implement a safe and sound passageway to transfer data over internet (Singh and Chatterjee, 2017).

c. Security issues (Backup, Availability, Confidentiality, Integrity)

The traditional model allowed us to control and manage our data by ourselves but in cloud it becomes the responsibility of the service providers and hence is very sensitive. This issue is rated as the most critical issue out of all the cloud computing issues. Which party is in charge of which security is a question that is not been addressed with conviction so far. The standards for such threats have not been set. The main issues can be discussed as account hijacking, malicious attacks, less secure interfaces and shared technology use. (Namasudra, Roy and Balusamy, 2017).

Data in cloud computing is stored on the cloud server which is managed by the cloud service provider or a third party. Huge chunks of data is divided up in to the small portions and stored on various servers. This makes it very hard to recover data if lost. In cloud computing, it is difficult to have a backup since the data is stored on third party servers. In case of failure there is no guarantee to recover the lost data (Namasudra, Roy and Balusamy, 2017).

Availability refers to something that is accessible as soon as the clients has demanded it. It includes data, service and infrastructure. Uninterrupted services is something that has to be guaranteed to customers to convince them for the migration on cloud services. It doesn't matter if there is an intrusion or a security break but the cloud services should be available to the user at any time. Since the guarantees are not provided by organizations a lot of organizations hesitate to migrate to cloud services (Rad and Rana, 2017).

Confidentiality refers to that only the person authorized to access information can access it. In cloud computing the probability of unauthorized people accessing information is increased due to the number of parties that are sharing the same resources such as similar networks, same data storage and similar programs. The threat of losing sensitive information to unwanted parties is an issue for major organizations to adopt cloud computing (Rad and Rana, 2017).

Integrity can be defined as that the person authorized can implement changes to the software, hardware and information. Integrity issues also influence the organizations decision to adapt to cloud computing. Sharing of the resources by multiple parties makes it essential for the service providers that the integrity of data is preserved. It would be a challenge to identify the culprit who makes unnecessary data changes and this will lead us to point fingers at the cloud service providers (Rad and Rana, 2017).

d. Privacy

Privacy protection of any computer system is a challenge. The challenge is complicated in cloud environment due to the number of parties sharing the resources and the uneducated users using this technology. Uneducated users do not know where the data is kept and stored and which users are authorized to access that data. Organizations may not adopt to cloud computing technology if the privacy is not provided by the cloud service providers, hence a mechanism is required to ensure that the data is given access to the authorized users and where data is stored is also out of reach from unwanted users at the same time (Werner, Westphall and Westphall, 2017)

e. Lack of standardization

The root cause of issues in cloud computing arise due to lack of standardization. There have been attempts to solve this problem using service oriented architecture (SOA) but it is still a challenge to convince this to the whole community of cloud computing (Namasudra, Roy and Balusamy, 2017).

f. Jurisdictional issues

Moving resources from one geographical area to another has always been a challenge and in the case of cloud computing the moving of data centers and servers is no easy task. Where data is stored is also decided upon some factors that may include availability of the network, load balancing of the cloud and the internet speed. This is also a primary concern as data security is the utmost priority for an organization to operate successfully (Rad and Rana, 2017).

g. Trust issues

Understanding the trust issue in cloud computing is a problem in itself. There is a certain level of belief that is linked with trust. The best answer to this issue is maximizing security. Reputation plays a vital role in achieving trust. We can say there are two types of trust issues associated with cloud computing. Persistent trust is related to a long-term relationship with underlying infrastructure. Dynamic trust will deal with small term and flexible information. Weak trust, occurs when the information about a particular activity is not transparent this creates a problem for an organization in terms of data security and results in customers having a weak relationship with their Cloud Service Providers in the near future. Lack of customer trust occurs when the Cloud Service Providers inquire about some information from their customers which is personal, this supply chain leads to suspicion making the Customers

distrust their Cloud Service Provider. The questions here arise about data security in the cloud servers. The Customers generally pull out of such activities due to the unknown risk (Namasudra, Roy and Balusamy, 2017).

h. Compatibility

The technical aspects as well as customization of the existing applications migration to cloud systems is a real challenge. The moving of applications from one place to another must be made easy and efficient. Compatibility issues should not occur after moving of an application from one place to another and this is a big challenge. Integrating current systems to cloud servers is a challenge which needs to be addressed and the other problem is it requires a certain expertise which is not common (Gangwar, Date and Ramaswamy, 2015).

i. Technological readiness

This issue deals with the technological infrastructure and human resources within an organization. The adoption becomes much more difficult based on less availability of infrastructure and human expertise. Organizations have to keep track of their organizations capabilities to assess if they are capable of adopting cloud computing effectively. It becomes important that the analysis of the capability of an organization is done efficiently to make a decision to transfer themselves to the cloud computing technology otherwise it will result in failure automatically causing a negative mindset towards adaptation of cloud computing in general (Gangwar, Date and Ramaswamy, 2015).

j. Attacks on cloud computing

Cloud computing is open to many attacks from malicious users all around the world. This is a very critical issue in a cloud environment. There are a lot of possible attacks that come up while discussing the cloud environment. Denial of Service Attack occurs when many invalid requests are sent to a server, this causes a denial of service. Many malicious users send invalid requests to the cloud server so they can access the sensitive data stored in the cloud server. Cookie Poisoning occurs when malicious users modify the cookie to get access to valuable data. This condition is referred to as cookie poisoning. Distributed denial of service (DDOS) occurs when the accessibility is fallen into the hands of malicious users or attackers. Virtual Library checkout occurs when a virtual machine being used by the company is upgraded by the workers on their personal machines, in this case any of the workers in the organization can be the possible attacker. Migration attack occurs when the cloud infrastructure is being moved from one place to another. During the process of migration sensitive data can be stolen in a number of ways and this is known as the migration attack. Encryption attack occurs when a malicious user tries to extract information which he is not authorized to do so. This can be done by creating various security problems. DNS attack occurs when the malicious users identify the name of server when it is being called, As soon as the servers name is compromised the malicious users can access data from the server if proper security protocols are not applied to the data stored on the cloud server. Sniffer attack occurs when unauthorized users can access and read the data contents. There are many sniffer programs which can trace data which is travelling on the cloud network. (Namasudra, Roy and Balusamy, 2017).

VI. CLOUD COMPUTING IN EDUCATION

Despite the offering of a number of benefits to higher education such as scalability, powerful resources and flexibility the rate of adopting cloud computing is very low. Only 4 % of existing cloud services are deployed in education. This figure needs to be increased but this is not an overnight process due to the number of challenges this new technology brings along with itself (Alharthi et al., 2015).

Two major barriers can be seen while accepting the implementation of cloud technology. Cultural barriers and Technical barriers. Cultural barriers appear of more importance as compared to technical barriers. In addition to these barriers there are other concerns which include, security, anonymity, responsibility, monitoring and privacy. Cultural barriers poses various challenges which includes the lack of interest of teachers to the follow the technological progress and the mismatch between digital immigrants (teachers) and the digital natives (students). The major issue in adopting cloud technology is from within the organization rather than external factors. Somehow teachers must be made aware of the technological benefits of such technologies by proving to them that these technologies can bring more efficiency to their teaching jobs. Planning and higher leadership needs to get involved to train the teachers on how to use these systems so they can recognize their real value. This is necessary to avoid empty virtual archives. The evolution of technology is so rapid that if a teacher gets familiar to one technology and starts to adapt it a new or better version is discovered. This creates confusion and frustration so the teachers look out of what will be the next development failing to recognize the current technological trend. Technical barriers may include internet speed and the security issues that cloud computing is still vulnerable to (Hartmann et al., 2017).

Construction of Digital resources in education is essential due to a number of reasons. The reach of the resources is significantly expanded and the sharing rate is boosted as well. The problems that we face such as unequal distribution of resources among various institutions can be tackled by the creation of digital resources using cloud computing. The teaching cost as a whole can be saved meanwhile improving its quality in the process. The advancements and maturity of cloud computing will be the most important aspect in achieving digital resources. Dealing with the issues and challenges of educational services in cloud can be a major advancement for the universities all around the globe. (Jiang and Xu, 2016)

A model was proposed to apply cloud computing on educational institutes in India and there were some challenges that were defined as Affordability, Accessibility and locational disadvantage. Since the application of cloud computing is applied on private sector because of the lack of resources in the public sector hence affordability is a major issue for the students to go to such schools. Limited infrastructure makes it difficult for all the institutes to adapt to the latest technologies such as cloud computing. Locational advantage will exist since the rural areas in India have limited exposure to technology hence making it difficult for them to implement the latest trends in technology (Patra and Das, 2013).

Kyushu University in Japan has recently applied cloud computing services on their university, the major issues they found were Confidentiality, Availability and integrity (Fujimura, 2017). They have also found some solutions to these issues and managed to implement cloud computing nevertheless (Fujimura, 2017).

Majalid's (Almajalid, 2017) paper discusses that there are some advantages of cloud computing adoption in the education sector but the disadvantages still remain which need to be looked at. Highlighted concerns were latency, security, reliability, privacy etc. The paper also discusses briefly the successful adoption of cloud computing in East Michigan University, University of Westminster, University of California and Kentucky's Pike County Schools. A framework was proposed for Saudi Arabian universities to adopt cloud computing but there are still concerns regarding security aspects and model validation which need to be studied further (Almajalid, 2017).

A research was conducted on how the stakeholders view the security issues that affect universities in South Africa (der Schyff and Krauss, 2014). The research was however limited for studying only the localized events, it was also limited on the number of universities that participated in this research. The discussion was on higher education but the participants were from general IT backgrounds, however the participants were professional. It was recommended that further works should be done to uncover even more threats for cloud computing adoption and it would be better if professionals from academia background were participating (der Schyff and Krauss, 2014).

E-learning in Saudi Arabia was discussed with various electronic based services by Al-Shwaier (Alshwaier, 2012).The major discussion was on discussing various type of cloud service tools that could be used by the universities however there are going to be some challenges in the adoption process. The issues that were discussed were security threats, Data Lock in and unsolicited Advertising. The paper concludes that due to the poor facilities in higher educational institutes the students are going to other developed countries to achieve higher education and it's about time the key issues get highlighted and a solution should be proposed so Saudi universities can be in competition with other developed countries (Alshwaier, 2012).

A comparative study was made between Middle East and Europe. The primary discussion was on cloud computing adoption and how it varies form one continent to another. Europe was far ahead in adopting up to date technology and Middle East preferred traditional technology. There were still some security issues that needed to be dealt with, Europe had established special centers to take care of the security concerns and in the Middle East countries like Oman and Qatar are working on security issues that include Privacy, Integrity and security. Teaching through cloud computing is just in the beginning phase in Middle East (Odeh, Warwick and Cadenas, 2014).

Palestinian higher education uses electronic system to look at attendance, insert marks and look at various emails but they needed to make this service usable for students and teachers in a way that it could be used anytime and anywhere. They discussed cloud computing in detail to solve their problems however the issues of cloud computing were also discussed which were Data Integrity, Privacy and Confidentiality, Data location and Relocation and Data Availability (Naser, Ghosh and Atallah, 2016). This paper solved the problem for a university by encrypting data but this is not a feasible solution for everyone in the world and the number of issues that were discussed in this paper are also limited.

A research was done on higher educational institutes of Oman and a framework was proposed to adopt cloud computing, the challenges that were discussed in this paper were related to Risk, Cost, technical incompetency and issues related with trust. Cloud computing is a technology for the future and is here to stay but evaluation of the tools is absolutely crucial (Alkindi, Haynes and Arockiasamy, 2015). The issues and the challenges should be identified in detail so maximum benefits from Cloud Computing can be achieved.

Cloud computing was adopted in higher education institutes in Malawi and a study was also done on this. The study discovered the factors that affected the cloud computing adoption. There were several limitations such as security, data integrity, jurisdiction problems and legal issues. Providing bandwidth was resulting in high costs which was a problem as well (Makoza, 2016). The factors identified in this paper were found based on data used from secondary resources. Further research was also recommended by the author on a larger sample size which should focus on higher educational institutes and target the aspects of organizational, technological and environmental context.

Cloud technology has threats and it is mostly related to security. The research has been carried out in UAE. The threats that are discussed in this paper are Integrity, Availability, Confidentiality, Data security and Application security (Ishaq and Brohi, 2015). The identification of the issues and challenges has become important because once they are identified than there is a need to propose solutions so adoption of cloud computing is made easier since it is going to benefit the business in the long run and is a requirement to stay competitive with other developed countries.

Identification of Issues and Challenges from various studies

Author	Geographical Region	Issues and Challenges
(Alkindi, Haynes and Arockiasamy, 2015)	Oman	• Cost • Technical Incompetency • Trust
(Almajalid, 2017)	United States of America	• Latency • Security • Reliability • Privacy
(Alshwaier, 2012)	Saudi Arabia	• Security Threats • Data Lock-In • Unsolicited Advertising

(der Schyff and Krauss, 2014)	South Africa	• Security Issues
(Fujimura, 2017)	Japan	• Confidentiality • Integrity • Availability
(Ishaq and Brohi, 2015)	United Arab Emirates	• Availability • Application Security • Integrity • Confidentiality
(Makoza, 2016)	Malawi	• Security • Data Integrity • Jurisdictional Issues • Legal Issues
(Naser, Ghosh and Atallah, 2016)	Palestine	• Data Integrity • Privacy • Confidentiality • Data Availability • Data Location
(Odeh, Warwick and Cadenas, 2014)	Oman and Qatar	• Privacy • Integrity • Security
(Patra and Das, 2013)	India	• Affordability • Accessibility • Locational Disadvantage

The benefits of cloud computing to higher education system is no mystery. It is difficult to solve the challenges that this technology poses. Adapting to cloud computing storage is a challenge. Further cloud computing challenges relate to the technicalities, security, management issues and service issues. Middle East Countries are in the process of improving its connectivity between the urban and rural areas. Internet connectivity is being made swifter and the network is being expanded in the rural areas. Weakness of the communication system is a challenge in adopting cloud computing infrastructure with respect to higher education. Cloud computing requires an internet with high speed, failure to do so will result in slow data storage and limited access which will result in cloud computing to be ineffective. Lack of experts in cloud computing in the Middle East is another issue to adopt this technology. This issue challenges its implementation in higher education institutes. Universities have to rely on the consultancy provided to them by external organizations. This issue must be addressed by training the local institutes, local organizations and the people of Middle East. Once the expertise is in abundance this challenge can be answered very effectively. Privacy and security threats pose another challenge in adopting of cloud computing in higher education. The process of migrating current systems to cloud technologies opens many pathways for malicious users to exploit sensitive data. A lot of sensitive data is at stake and it includes personal information of students, teachers and the university employees. The education institutes will be unaware of where data is stored and this creates a problem in making the decision to move to cloud technologies. Data is open to various attacks which must be addressed. (Shahzad *et al.*, 2016)

Based on this evidence it could be a good move to implement such methodology in higher education in Middle East so the benefits that Kyushu University is taking advantage of can also be fully utilized by the Middle Eastern Universities too but the implementation may only be done after a deep analysis of the Middle Eastern environment as opposed to that of Japan. It is safe to say that all involved parties will walk away with advantages if the mapping of cloud computing and e-learning organizations prove to be a success.

VII. CONCLUSION AND FUTURE RESEARCH

Cloud computing is playing a vital role in transforming infrastructures of all kinds of Information technology organization all around the world. The major benefit is that of reduced cost and what makes it better is that the technology does no compromise on effectiveness and efficiency, in fact it makes the technological process a lot more efficient. Applying cloud computing on an organization as not as simple as it seems due to the number of issues and challenges it brings along, such as data storage and computing security, confidentiality, integrity, availability, jurisdictional issues, compatibility, trust issues, possible attacks on cloud computing, lack of standardization and technological readiness.

Cloud computing is proving to be a lot of success when applied on higher education. Middle Eastern higher education has not taken much advantage of this technology due to various issues and challenges. This paper will identify the issues and challenges of applying cloud computing to Middle Eastern higher education institutes. These issues and challenges must be identified in detail so they can be addressed as appropriate. Future research should be carried on, by applying it to a bigger sample size and studying different environments and also to address these issues by providing possible solutions.

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