

# Major Differences of Cloud Computing Adoption in Universities: Europe vs. Middle East

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## ABSTRACT

The extensive use of cloud computing in educational institutes around the world brings unique challenges for universities. Some of these challenges are due to clear differences between Europe and Middle East universities. These differences stem from the natural variation between people. Cloud computing has created a new concept to deal with software services and hardware infrastructure. Some benefits are immediately gained, for instance, to allow students to share their information easily and to discover new experiences of the education system. However, this introduces more challenges, such as security and configuration of resources in shared environments. Educational institutes cannot escape from these challenges. Yet some differences occur between universities which use cloud computing as an educational tool or a form of social connection. This paper discusses some benefits and limitations of using cloud computing and major differences in using cloud computing at universities in Europe and the Middle East, based on the social perspective, security and economics concepts, and personal responsibility.

**Keywords:** *Cloud Computing, Education, Social differences, Europe, Middle East*

## 1. INTRODUCTION

In recent years there has been a rise in the use of cloud computing. Advances in technology such as network speed, distributed and grid computing, and high storage availability, the common problems of limited computational power and limited physical data storage can be ameliorated.

Cloud computing adopts the method of working completely at the servers end. It is common to have two views in cloud computing. The frontend part is the interface which is visible to the end user who will use the application. The back end consists of multiple computers and data storage systems, which are responsible for running the tasks assigned by the user. The front end runs the cloud computing system. Each job will have its own VM assigned to it, which means that many users can be allocated to a single server without waiting in a queue or being notified of the presence of other users working on the same server.

The importance of cloud computing in higher education has increased rapidly with the passage of time and it is obvious that its use and its importance will continue to grow in the future. Probably this is due to its benefits in teaching and learning among other aspects. Cloud computing has been used in business, social and personal life, as well as in teaching at higher education through Information and Communication Technologies (ICT), as discussed by [1]. In the case of teaching, cloud computing can add greatly to the teaching and learning process if it is properly used. It can increase the effectiveness of the study process by adding in supplementary aspects which were not present before.

## 2. BACKGROUND

Although started in the sixties, cloud computing gained popularity in the nineties while going through many phases including grid, Software as a Service (SaaS) and application service provision (ASP) [2,3]. Cloud computing moves data and computer away from desktops and other portable computers into large data centers. Therefore, applications are now delivered as services over the internet from within cloud infrastructure. The user can access to this service or his data and files with a web browser from the servers of the cloud service provider [4]. Another perspective of cloud is it is a type of computing where elastic and scalable IT enabled capabilities are provided as a service to external consumers by using internet technologies. Cloud computing can easily be implemented in universities as an extension of service oriented architecture [5]. The evaluation of information technology started with the internet, and in last few years, numerous services have moved into online from traditional processes. However, this transformation was not easy as it required adequate technology, fast transactions and secure access for large number of users. In solving the problem, cloud computing works as a better alternative, especially in educational environment.

## 3. LIMITATIONS AND BENEFITS

The use of cloud computing in universities requires careful analysis from all perspectives including risks, limitations and benefits. Based on the analysis, the decision must consider the real needs and align with institutional strategy. The result of non-cloud environment is another important decision making factor. By using cloud computing, a gain that goes

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beyond the capital expenditure and recompenses the related risks must be achieved. The following table shows

the main benefits and limitations of cloud computing in universities.

**Table 1:** The main benefits and limitations of cloud computing in universities [6]

Benefits	Limitations
Can be accessed into applications from anywhere	Cloud does not support all applications
Applications are free to use or pay per use	Personal security and data protection is yet not foolproof
Anytime (24/7) access to content and system	Organizational support
Available to advance research and business environment	Distribution of intellectual property
Using green technology protects the environment	Protection and security of sensitive data
New technologies are open and easily available to students	Solution maturity
More functional capabilities	Little confidence
Available for offline usage with more synchronization opportunities	Standards devotion
Support for learning and teaching	Internet connection affects work process

Many of the risks and threats associated with cloud computing environment are transferred to the cloud service providers. Based on this observation, the major risks of adopting cloud computing in universities are : limited customization, availability and performance, security, high price for on-demand service, regulatory requirements and fewer cloud service providers.

Since sharing knowledge and research result is one of the core use of cloud environment in universities, external service providers make the system more vulnerable and easier target for attackers [7]. Therefore, there are different aspects of security risk including isolation failure, loss of governance, data protection, lock-in, compromised management interface, compliance risk, malicious insider and incomplete deletion[8]. The data in cloud and intellectual property stand as the main concern of the clients.

It is clear that the most influential factors in making decision about using cloud computing are cost and data security. Managerial position in security and risk management along with payment per use are the keys of cloud computing in universities. In addition, the cloud system needs to add little more expense to include environmental protection. Finally, universities and educational institutes should consider the opportunities and possibilities that cloud computing offers for the students and researchers.

#### 4. SOCIAL PERSPECTIVE OF USING CLOUD COMPUTING IN DIFFERENT SECTORS

Cloud Computing is one of the most important new concepts in technology. It is said to be very beneficial in terms of business for its cost effectiveness, data security, scalability, mobile access and so on. Many businesses are shifting their whole infrastructure towards it. It is, on the other hand, also believed that it can only be used in business, which might be a completely false concept. The cloud is present in the daily life of people; it has changed the use of social applications like Facebook, Twitter, and LinkedIn etc. Social websites are used by mobile devices which are based on the cloud from

everywhere without paying for it. The widespread use of all these social websites is proof of the cloud's importance. Without the use of cloud computing the success of these social applications would not be possible. Globalization is the very first outcome of cloud computing. The growing popularity in news channels, the rise in social media, Skype, email clients, and all these online applications are the result of some sort of cloud computing. There is a huge difference today compared to as it was only a few years backbit seems impossible that a few years back people were not able to make an international phone call for less than \$1/min and nowadays it is almost free of cost, simply by using cloud computing and a free application service.

#### 5. INTRODUCING CLOUD COMPUTING AT UNIVERSITIES

In the era of cloud computing and many other modern technologies, some old technologies could not cope and ultimately become obsolete. This happens fast; some technologies which were at their peak ten to twelve years ago have now completely vanished. They may have not been friendly, or reliable, or fast, or any other reasons led to them becoming obsolete. Their place has been taken by friendly, fast, reliable, efficient and useful technologies. It could be said that human behaviour always prefers something reliable and simple; this is found in cloud computing technology.

The need for cloud computing is seen worldwide. However, there are some countries which are reluctant to adopt the new technologies. According to [9], Many Middle Eastern counties are under-developed, and prefer traditional learning methods. In addition to this has given thought to the lack of professional training that is present in Middle Eastern countries, so people are not aware of the technology and cannot utilize it according to the level of standard that is required.

By contrast some technologies used in UK universities over ten years ago were made obsolete; their place has been taken by more modern ones. Among them we find:

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Scantron sheets technology was used by the universities in UK for multiple choice questions. The multiple choice questions were given on those sheets, which then would be graded by the Scantron scanner. Nowadays, thankfully those scantrons have been replaced by multiple choice question machines on learning management system (LMS). These new machines are accurate, fast and affordable. According to [10], UK had its first Cloud school on networks in the George Stephenson High School in Killingworth, where there are labs located to teach students via the provided technologies of cloud computing. There has been a very positive response, because expansion is also planned in the year 2014 for local and overseas campuses.

Whenever a teacher wanted to show a video they had to switch the DVD on and then start the video; students could not watch it without being in a lesson. Now, this has been replaced by LMS. Whenever and wherever a student wants to watch a video that has been placed on LMS, they can watch it using a Smartphone.

There was a time when teachers would bring color transparencies which would then be placed on the overhead projector to show to the class. Today, teachers come to a lecture room without even having an attendance sheet where to record attendance. Everything is on LMS, from where teachers can manage many things including taking attendance.

Microfiche was a media tool used to view old newspapers in universities. These were available to students and teachers to find something of interest in old newspapers. Today, you would not find a single library where this tool is available and used by students. All these have become obsolete, now new technologies have replaced them.

## 6. MAIN DIFFERENCES OF USING CLOUD COMPUTING BASED ON SECURITY CONCEPTS

Cloud computing technology has proliferated at a rapid pace; it now has an extensive and wide use in today's digital world. Cloud-based applications are diverse, ranging from social websites to email clients, gaming and much more. It has become so significant in daily life that it is almost impossible to withdraw from it. However, every country or organization has its own security concerns with the cloud. There are some differences over the security concept by different parties of cloud computing. These differences are normally justified due to their requirements and use.

The European Union is establishing a digital single European trade market. For this purpose, ENISA has established a research laboratory in which it has hired the top security researchers from European universities, with the purpose of enhancing the existing trade between the member countries. These enhancements must operate

using the cloud's resources either eliminating or diminishing its security flaws.

Some of the main security issues include data privacy, security and integrity. For instance, once data is uploaded to the cloud, it is out of control in some respect. Essentially, end users give data into someone else's hand. In the worst case scenario, the cloud storage may crash or may lose data, as stated in [11]. In order to keep data safe and secure at least from leakage and loss, every university and organization wants the cloud service providers to keep critical data in the cloud storage in their own country. Different universities in Europe are doing research on this cloud-based E-single trade market.

The concept of cloud security for the universities of Israel, for example, is different. They seem to be a lot more careful about their data. They have established their own agencies for this purpose. For example the ILITA Israeli Law Information and Technology authority aims at making the cloud more useful and more secure for their people and government, as discussed [12]. ILITA's main legal challenges include standard form contracts, cross border transfers and monitoring compliances.

One of the main centers in the Middle East region, Oman and Qatar, are already working on security as there are limitations to the cloud's security. They have introduced Oman's Electronic Transactions Law in order to protect the work done on cloud computing. The law aim to provide safe environment for e-transactions to do so and provides a list of requirement to be implemented by service providers such as coding the general keys, provide additional firewalls, and create information filters stated by [13].

## 7. CLOUD COMPUTING IN ACADEMIA

Cloud computing has accelerated the use of many social websites, academic applications, communication systems and many more. In academic institutions, almost every application and program is based in the cloud. Teachers, students and administrators are all using the same applications, based in the cloud, from anywhere by their smart phones. There are a number of applications running in universities which are based in the cloud. Among these are online learning management systems, progress tracking systems, library management systems, fee systems, and student record systems, to name a few. All of these systems reside in the cloud which can be accessed from any place using an authentication mechanism.

Along with all these benefits, the cloud brings concerns also for its users in terms of security. Data loss, leakage, confidentiality and privacy concerns are the key issues which most teachers face when teaching in an institute, as many teachers may use the same cloud resources at once, as discussed in [15]. The negligence or carelessness of a single person can cause harm to the

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overall system; this can lead to data theft or data loss for someone who is very careful and vigilant about their data. The loss or theft of private data due to someone else's carelessness can lead to disputes among the teaching staff. To manage this very serious scenario, cloud providers are now assigning separate instances to each person where the private data can be authorized in a more secure way.

University servers contain a lot of sensitive data including research result, scholastic records of students, employment account etc. To protect this sensitive data, it should be maintained within institute data centers. The rest of the data can be externalize to achieve maximum scalability and performance. To solve the problem, there are few methods that universities use based on their need and policy[15]. The most common methods for this includes firewalls, federated identity management, data masking and encryption. Cost is one of the prime factors for selecting data protection method. Encryption is the simplest and cheapest solution against data hack. It is clear that the most influential factors in making decision about using cloud computing in both European and Middle East universities are cost and data security.

Cloud computing may be a decade-old phenomenon so far, but it is still evolving and maturing as a technology. As discussed by [16], this might make cloud computing an on-going experiment while progress in standards is decided and security factors are tightened up. In short, the technology is not fully regulated or controlled, and it should only be used at one's own personal risk.

## 8. CONCLUSION

Based on our analysis, we find major differences in dealing with cloud computing between the Middle East and Europe. The Middle East universities seem to prefer traditional technology, while European universities such as in the UK prefer keeping up-to-date technology. In spite of numerous drawbacks and security limitations, it is clear that cloud computing might be the most suitable approach for technology in the future in any university. However, there are security issues which exist in both regions, yet they both have their own laws which would regulate the data of customers accordingly. There is a vast gap between the Middle East and Europe when it comes to the implementation phase. Europe is highly advanced and is using cloud computing in their education system to the full extent. The Middle East has just begun the initial phase in order to offer teaching through cloud computing.

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