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POTENTIAL BENEFITS AND OBSTACLES OF CLOUD COMPUTING IMPLEMENTATION IN HIGHER EDUCATION INSTITUTIONS(HEIs): A DELPHI STUDY

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Abstract
In the education sector, cloud computing is an apparent innovation to guarantee the accessibility and sharing of assets through virtualization. This research aims to identify the potential benefits and obstacles of cloud computing implementation for the Learning Management System (CC-L) in Malaysia Higher Education Institutions (HEIs). Although the literature has discussed the benefits and obstacles caused by the implementation of cloud computing, the analysis needs to be done in the perspective and context of the relevant research. Therefore, the Delphi survey technique used to identify the potential benefits and obstacles among experts from HEIs and cloud service vendors. This finding expected to drive on how to overcome their limited resources to address the obstacles identified in cloud computing implementation success. Hence, the gap in the literature addresses in this study by focusing on different perspectives and countries. The result indicates the agreements of eight benefits and seven obstacles recommended that belief could support a decision of cloud computing implementation.

Keywords-- Delphi, virtualization, cloud computing

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OVERVIEW

The capability to create a dynamic Information Technology infrastructure in developing countries has been challenging for many sectors. Cloud computing is the advanced distributed computing to provide virtual monitoring to these issues. The development of cloud computing will alter the stakes for entrepreneurs, small and medium businesses, and researchers, and governments. It is improvement based cloud technology where the computer technology used for virtualizing resources and presenting services over the internet network (Khajeh-hosseini&Sommerville, 2010).

Cloud computing technology has been shaped up by years in virtualization, utility computing, and advanced network technology. This is a model of information and network technology that promises the provision of computational resources on demand and abstraction of technical details by the clients. The different types of cloud computing services are:

- Infrastructure as a service (IaaS): Physical equipment or hardware and network infrastructure are presented as services to clients. This enables an organization to rent these resources despite cost expenses to purchase servers equipment and networking tools (Bhatia &Lala, 2012).

- Software as a Service (SaaS): Software or application program utility is introduced as services on the internet alternatively than as a software program to be purchased by any customer. Examples are Google web-based workplace functions (GoogleDocs, spreadsheets, etc.) that are present in most activities in education. However, the information is not only stored in the cloud storage but also in user utility application, with the person requiring only a browser application. The best-known examples are Google Apps for Education and Microsoft education which provide verbal exchange and office functions such as e-mail and shared documents and folders(Yadav, 2014).

- Platform as a service (PaaS): This layer refers to providing software services to support the whole relevance development process including designing, completion, debugging, testing, exploitation, operation, and support of rich Web applications and services on the internet (Nasr &Ouf, 2012).

The technology of cloud computing promises numerous benefits in the higher education background by understanding different information and knowledge (Dinca et al., 2019). This advanced technology is an innovation that is emergent in the industry of Information Technology and the education system. HEIs around the world are facing a challenge in bringing Information Technology skills to facilitate teaching and learning, research, and development activity in a typical university with not implementing cloud computing technology(Sultana et al., 2019). Many higher education institutions are facing challenges of the absence of resources, which increases the importance of resource sharing. As there is an issue of resource sharing, cloud computing technology is the ideal solution (Kawatra & Kumar, 2018). The implementation of cloud computing in the higher education sector will solve the problem of a lack of resources. The education system can access the benefits of cloud computing from the perspective of infrastructure, platform, and service provided by the service vendor.

Thus, this paper is composed of five sections. Section one of this paper presents a basic overview of this research. Aim of the study provided in the second section. The third section of this study discusses the literature review followed by methodology in section four. Data analysis discussed in section five and at last, the sixth section offers the conclusion of this paper.

AIM

Aims of this study are to determine the potential benefits and obstacles for a viable cloud computing implementation in Malaysia HEIs from the perception of its stakeholders. This would enable academicians and researchers from HEIs and local technology service vendors to identify its benefits and obstacles

to address the identified obstacles in ensuring the success of cloud computing implementation.

LITERATURE REVIEW

Cloud computing technology is a model that enables easy, on-demand network access to share configurable computing resources such as networks, servers, storage, applications, and services that can be provided quickly with minimal management effort by consumers or service vendor interaction (Yadav, 2014). It is already being used in various ways such as free social media and email services like Facebook, Instagram, Google and yahoo email.

Most of the HEIs highly dependent on information technology to service their teaching and learning activities. Many services application is offered as low cost or free to education, with much higher performance than can be provided by the educational institution. This advanced technology, hence allowing the majority of educational institutions no longer to host their data centres with expensive infrastructure, staff salaries, and computing resources which are infrequently fully utilized. The brief of this strategy has analyzed some of the benefits and challenges of cloud computing for the education sector (Yadav, 2014).

Few studies, however, conducted in various countries. In sub-Saharan Africa (Dahiru et al., 2014; Hailu, 2012; Mtebe, 2014; Odeh& Warwick, 2017; Sabi et al., 2016; Scholtz et al., 2016)viewed the similar perspective of study, to determine the influences of cloud computing implementation success among various sector include HEIs. The research in such technology are exciting in this country due to the technology are still in infancy and slow in developing country like Africa. Other than that the similar research is quite many in other countries like Arab Saudi (Alkhalil et al., 2017; Qasemet al., 2019; Saleh et al., 2018; Tashkandi& Al-Jabri, 2015) and India (Chormale& More, 2016; Sultana et al., 2017).

To the best of researcher understanding, there are a few studies carried out to examine the use of cloud computing or to demonstrate the immediate effect of cloud computing implementation to actual HEIs. In summary, cloud computing technology is still in its infancy stage informal education sectors especially in developing country and there are potential areas that are yet to be explored. In this manner, this paper contributes to filling the literature gaps identified in this emergent area.

The Benefits of Cloud Computing Implementation.

The technology of cloud computing offers numerous advantages to the end-users, but to take advantage of cloud computing and to make the cloud reasonable, the data, and services hosted in the cloud must be secured. Cloud computing provides flexibility, availability, reliability, scalability, and cost-efficiency to the users, but is also exposed to new security risks (Bhayal, 2011). These computer systems are then accessed by users via a network such as an internet. Due to the benefits of cloud computing compared to traditional computing, this technology being employed on a global scale especially related cost-saving. Furthermore, Bedward&Fokum, (2014) states that benefits such as lower information technology investment expenses, and access to key technologies, application, and skilled information technology workers allow for an organization to have a slight, though temporary, competitive advantage compared non-cloud users.

A great concern is related to data security as both software and data located on remote servers that can crash or be lost without additional warnings (Bhure&Bansod, 2014). System crashes and loss of data can lead to large business losses (Parte, 2017). Even if it seems not very reasonable, cloud computing provides some of the key security advantages for individuals and companies using LMS based cloud computing solutions.

Bhureet al., (2017)states that the cloud is a one-time investment with very good returns in terms of computing capabilities and maintenance costs. End-users benefit from all applications without having to spend a lot of computing infrastructure and data storage. In another study (Chandra & Borah, 2012) examined the cloud computing enhanced network flexibility and agility to learn and reduce the cost and difficulty of web learning resources and services. Bhure & Bansod, (2014) indicate that education system performance also could be improved. Since the education system on personal computers, laptops, etc., the performance of devices is a great concern. Often, applications located on local servers may experience low speeds, malfunctions and poor performance due to insufficient computing infrastructure overcoming this shortage.

Other than that, since cloud vendors are responsible for running and monitoring all software regularly for some customers, it is their job to constantly update the software to the latest standards at all times, which may take a back seat if the application is in the company. The updates to the latter will automatically be applied since the client device is connected to the main cloud. (Parte, 2017). Cloud computing also allows for the rapid replacement of a compromised cloud server without cost or major damage. It is very easy to create a virtual machine clone so that the expected downtime can be significantly reduced (Bhure & Bansod, 2014; Selviandro & Hasibuan, 2011). Besides, monitoring the use of cloud computing to the data access becomes easier as only one place that should be monitored, not thousands of computers owned by universities. Security changes can also be easily tested and implemented as the cloud is a unique entry point for all customers(Fernandez, 2014; Parte, 2017).

Cloud computing also provides a large capacity of storage; these criteria could address great and extensive characteristics from could computing. Large scale storage in cloud environments provides advantages for users to determine the storage capacity they plan to use that are adjusted to their needs and abilities of the institution. On the user side of the cloud-based system; customer fragmentation is no longer the main focus while key parts of the application and data are stored in the cloud so that new customers can connect quickly. Imagine what would happen today if a laptop holding the exam question was stolen. (Selviandro & Hasibuan, 2011).

Furthermore, according to a study by Abubakar et al. (2014), by using cloud services, HEIs could minimize their expenses to develop e-learning systems and simplify their implementation processes as e-learning systems are already developed and managed by cloud e-learning providers. Bhure & Bansod, (2014) suggested that by using great storage and high-performance computing power, the cloud in the learning system can provide high-quality service. This is possible because the cloud-based support system in the learning system detects node failure and can be moved immediately to another node. Besides, the high availability system, with huge storage so that many learning resources can be collected.

METHODOLOGY

Delphi Technique (El-gazzar, Hustad, & Olsen, 2016; Gupta, Misra, Kock, & Roubaud, 2018)

Delphi is a supporting technique that involves expert judgment to individual feedback through a repeated response and then submits the feedback to the research owner who would process the appropriate responses looking for central tendencies and motivations(Hasson et al., 2000; Pill, 1971). This technique developed in U.S in the 1950s by the RAND Corporation.

Nevertheless, it was only started by Dalkey and Helmer in 1963 for measuring variables that are intangible by describing the knowledge and abilities of a diverse group of experts through iterative processes. This is particularly useful in situations where an individual's assessment must be addressed and consolidated to overcome an absence of agreement among participants (Powell, 2003). The four key stages to be examined in the Delphi process are the anonymity of the Delphi panels, an iteration that enables panelists to enhance their opinions and controlled responses that allow for statistical analysis and non-statistical data analysis (Rowe & Wright, 1999).

The Delphi has been mentioned as a fit technique for building consensus through the series arrangement of surveys presented utilizing numerous cycles to gather information from a selected expert (Grisham, 2009; Hsu and Sandford, 2008). It is viewed as a subjective, long haul determining system by a few or a blend of subjective and quantitative strategies.

Since its underlying initiation, Delphi has effectively actualized in an assortment of territories including program arranging, needs evaluation, arrangement assurance and asset usage (Hsu and Sandford, 2008). Rowe and Wright, (2011) portrayed Delphi as "to have filled a profound need of scholastics and specialists for organized methods for evaluating and consolidating human decisions". In their investigation on the past, present, and future possibilities of Delphi, Rowe and Wright (2011), found that by and large it is by all accounts a strategy that empowers analysts to ask and answer inquiries that they didn't have the foggiest idea how to address beforehand.

Subsequently, the Delphi procedure is ostensibly generally reasonable to be utilized for this research that focuses on determining the possible benefits and obstacles for current cloud computing implementation in HEIs in Malaysia. Not at all like other information gathering strategies, Delphi utilizes multiple iterations that permit the participants to re-survey their underlying decisions (Grisham, 2009). This technique also adapts El-gazzar et al., 2016; Gupta et al., (2018) to assess the stressed factors in the distributed computing usage system.

Delphi Survey

Potential benefits and obstacles of cloud computing implementation in the HEI system among expert participants could be identified by providing their suggestion to the four questions in Section B of the Delphi questionnaire. Two-cycle Delphi questionnaires have been distributed by email as the main channel with follow-up by a phone call or WhatsApp massaging where needed.

For participants who chosen to have a face to face meeting session, necessary appointments were made. However, the face to face meeting session was not a practicable mode due to a high cost of traveling and interview via phone was arranged as an alternative way. Other than that a real-time survey form also created and distributed to respondents as an alternative to get feedback.

The Cycle 1 (C1) Delphi questionnaire has been divided into three sections. In section A, respondents asked about their profiles includes name, current position, institute and total years of working experience in the cloud computing research. This was to confirm that the participants meet the criteria as an expert as necessary by the Delphi technique.

It would also allow the researcher to determines participants in the particular sectors mainly government HEIs, cloud computing service vendors and academicians to support some balanced collection stakeholders. Section B involved the question related to this study's aim. It involves open-ended questions looking for opinions on the potential benefits that potency gained from HEIs and cloud computing service vendors and obstacles that may barrier tothe success of CC-L implementation in Malaysia HEIs. Section C involves the establishment of the 13 key factors analyzed through content analysis to facilitate the participant's knowledge of the determinants that have been discussed in the current literature.

Therefore, Cycle 2 (C2) survey summarized the finding of the C1 result and encouraged the participants to suggest other benefits and obstacles that they observed as important to the shortlisted. 18 of questionnaires returned from all questionnaires distributed and the breakdown of the participants through the purposive sampling technique, are presented in Table 1:

Table 1. Delphi survey respondent's feedback

HEIs	Academia			Cloud Computing Service Vendor		Others	Total Participants
	Prof	A. Prof	Sr. Lecturer	CEO	Executive		
UniKL	0	1	3	-		1	4
UTM	1	0	2	-		1	4
UTHM	0	0	1	-		1	2
UTEM	0	0	1	-		1	2
UMP	0	0	2	-		0	2
UNIMAP	0	0	0	-		0	0
MMU	0	0	0	-		0	0
OUM	0	0	1	-		0	1
Service Vendor	-	-	-	2	1	0	2
Total	1	1	10	1	1	4	18

In Table 1 above, from 32 surveys sent, 18 were returned with 56.25% and can be considered as anacceptable response figure. The academic participants were selected concerning their knowledge, experience, and published work in cloud computing technology. Those selected with at least 10 years' experience in related technology addressed and published in journals on the relevant topics. Besides, cloud computing vendors are those who are working or have experience serving their cloud computing services in any HEIs in Malaysia.

FINDING

The Benefits of CC-L implementation in HEIs

All participants agreed that the CC-L implementation in HEIs is important due to several reasons particularly in improving technology enhancement, enhancing accessibility, enhance quality teaching and learning delivery, improve education system availability, enhance mobile learning and providing an effective cost to management. To process the participant's opinion qualitatively into appropriate themes, a summative content analysis was utilized.

The summative content analysis approach is the practice of compiling and making systematically comparable information through the application of a coding scheme to the notes and data (Lune & Berg, 2017). It is also a technical approach for analyzingthe individual interpretation of the data through the systematic grouping of coding and identifying themes(Hsieh & Shannon, 2005). Based on the detailed analysis,data categorized using a group of coding and in this study,all the qualitative feedback have been categorized into 8 groups as shown in Table 2:

Table 2. The potential benefits of CC-L implementation

Group	Benefits	Statement	Judgment
A	Enhanced technology infrastructure and maintenance	23	13
B	Availability and flexible to be customized	18	11
C	Collaborations efficiency with other system and web	10	8
D	Reduces the costs of institution	11	11
E	Improved data and information management	7	5
F	Enhanced teaching and learning quality	16	10
G	Enhanced technology innovation	5	5
H	Enhanced security effectiveness	5	5

The results to support the previous benefits were given by 18 with 95 statements. 11 participant's responses to the benefits of CC-L implementation are when they believe that the system has the features of availability and flexibility to be customized (Group B). This benefit received the second-highest response recorded.The next highest by sequences are Group D- Reduces the costs of the institution, Group F- Enhanced teaching and learning quality, and Group C- Collaborations efficiency with other systems and web. The top five responses reflect the expectations for the enhancement of institution system opportunities that could be brought about by the implementation of cloud computing. Three groups received comments from the lowest number of judgment Group E – Improved data and information management, Group G– Enhanced technology innovation, and group H- Both groups received comments from only 5. As for Group H, it is believed that most participants prefer to look at CC-L implementation able to enhances institution security effectiveness.

In summary, most participants believed that the implementation of cloud computing in the teaching and learning system would be able to enhance technology infrastructure and maintenance (Group A).

Obstacles of the CC-L implementation in HEIs.

Other than to determine the potential benefits that could be brought by the cloud computing implementation, participants were also asked about the possible obstacles that may obstruct the success of CC-L implementation in HEI in Malaysia. The feedback to this inquiryis important for researchers to assess their similarity with other determinants that have been gathered through the literature. Similarly, over the feedback given, the researcher would be able to trace other important factors for the success of the CC-L implementation in HEIs in Malaysia. Similar to the previous investigation, all the feedback received has been categorized using the qualitative content analysis method. The whole revised opinion categorized into 7 groups of obstacles as shows per Table 3 below:

Table 3. Obstacle of the success of CC-L Implementation

Group	Obstacles	Statement	Judgment
A	Difficult to accept technology changes	10	8
B	Lack of awareness	5	5
C	High cost of facilities	5	5
D	Poor of Internet infrastructure performance	15	11
E	Poor of SLA knowledge	5	5
F	Poor management support and policy	6	5
G	System security and policy	8	7

From the 7 groups identified, allthe similar or almost similar comments mapped to the 7 important factors that have been identified through the literature. Six groupings are analyzed as similar to the CSFs identified and assessed in the Section C Delphi survey. Those groupings are Group A (Difficult to accept change), Group B (Lack of awareness), Group C (High cost of facilities), Group D (Poor Internet Infrastructure), Group F (Poor Management Support and policy) and Group G (Poor Security Management).However, one of the groups formed from the received feedback is new and deserves to be further analyzed for potential addition into the R2 Delphi survey which is Group E (Poor of SLA knowledge). SLA document knowledge is the factor that is not discussed and addressed in literature as an important factor in cloud computing. However, SLA knowledge analyzed as a new factor by 5 participants with 5 total of opinion statements and included in the R2 Delphi survey for further assessment in the subsequent Delphi cycle. The highest rate of obstacles suggested is Group D- Poor Internet infrastructure performance from 11 with 15 statements, followed by group A- Difficult to accept technology changes from 8 andGroup G- System security and policy which received feedback from 7.

The feedback from the C2 Delphi survey retained the earlier consensus from in C1 with recommended other additional benefits and obstacles. All groups of benefits reach consensus among participants on the benefits of the implementation of cloud computing in HEIs. Furthermore, obstacles revealed that only 54 out of 57 recommendations can be included under the obstacles identified based on the consensus attained in the C1 Delphi survey. However,one new suggestion did not reach the minimum level of consensus that was set at 25% (5 participants) which is "difficult to monitor" and is not included in the list as it only commented by two participants. On the opposing, no suggestion received to be accepted as a new obstacle in this survey cycle.

CONCLUSION

In summary, the key benefits that could be resulting from the cloud computing implementation in HEIs gathered from the expert participants reflect their opportunities on the improvement on the performance of the education system. Besides, they also anticipate the opportunity to improvise the education system that will make the teaching and learning delivery service more efficient and competitive overall. Ultimately, the participants' confidence that the implementation of cloud computing as supporting teaching and learning activities will be one of the important opportunities for enhancing technology innovation and performance.

All the expected benefits and obstacles that recommended are consistent with the previous study stated in the literature. One of the obstacles which quite contradicts is security which is the element analyzed as participant's concern of the attitude of related parties on security documentation and not about the security trust of cloud computing ability. Further research is required to educate and analyze the current practice of documentation security and the improvement need to be done by related parties on this issue of security seriously. Hence, it would be necessary for the related parties to highlight all the 7 obstacles identified to ensure the implementation could bring the technology innovation, improve the security and performance of current infrastructure in HEIs.

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