Factors Affecting the Adoption of Cloud Computing in Higher Education: A case of Higher Institute of Science and Technology-Ghadames

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Abstract—in the field of education, cloud computing is an emerging field in information technology, aimed to allow on demand access to a shared pool of computing resources that are provisioned by multiple providers. Because of virtualize resources through the Internet, in addition to dynamic scalability, cloud computing has continued to be adopted by more institutions. In spite of the manifest financial crisis, there has been increasing pressure for higher educational sector to deliver better services using minimal resources. In this paper, we investigate the main factors that may affect cloud computing adoption in Higher Institute of Science and Technology-Ghadames (HISTG). These factors were identified and tested using SPSS software, a powerful for editing and analyzing all sorts of data. A cross-sectional analysis method is used to answer the research questions based on Technical, Organizational and Environmental (TOE) framework. Furthermore, we present a case of comparative analysis by calculating the statistical mean for the factors of cloud computing adoption between HISTG and the similar work has been done in Saudi universities. The findings of this research study are to assist top managers of the institute for a decision-making to adopt cloud computing.

Keywords—cloud computing, computing resources, information technology, higher education

I. INTRODUCTION

Cloud computing becomes a new concept which is sprouting in the industry of information technology and academia. It is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources over the Internet [1]. Cloud Computing promises several benefits in the higher education landscape by understanding different dynamics and expertise in diverse domain [2]. Currently, there is a financial crisis and additional challenges facing universities in providing the required IT support for educational, research and development activities [3]. Furthermore, there is a huge increase of costs in higher education and a decrease of universities’ budgets. The Higher Institute of Sciences and Technology-Ghadames is one of the Libyan higher institutes currently facing some barriers that affect the education process in the institute. An interview with the Dean of the institute was conducted to identify the current challenges that affect the education process. The dean highlighted some of the challenges which include: the inability of the institute to save and secure the huge data related to students, lectures, and staff. However, using cloud computing model may solve above problems in this Institute, because it provides the ability for sharing documents, store data, and use online applications as needed. Additionally, it makes employee’s job much easier and data will be more secure stored in the cloud.

As highlighted in the study done by [4], universities can take the benefits of cloud based applications provided by different cloud providers and allow their staff and students to perform various academic tasks according to their own requirements. On the other hand, [5] pointed out that effect of cloud computing adoption has not been tested yet, where many education organizations think that cloud technology may provide achievable alternative model that will make reduction in costs and complexity while increasing operational efficiency. One of the important advantages of cloud computing is that the data can be scaled and provided to the customer on demand as per resource needed [6].

The paper in [7] concluded that the failure downtime by cloud provider, the complexity and compatibility of cloud implementation are the two concerns of cloud adoption in high-tech firms. While the study in [8], concluded that technology and organization context factors have a strong impact on the decision of adoption. Relative advantage of cloud computing, a high level of top management support and high competition intensity are all three factors that are positively impacting the decision to cloud adoption. Though several studies were done in Libya in similar subjects, no study was conducted on cloud computing. The following studies were proposed:

A case study conducted for ICT Utilization in Libyan Universities (Misrata and Al-Mergib) found that ICT knowledge and awareness is weak amongst staff and no ICT strategy in place, and only limited training programs are offered to IT staff [3]. [9] Found that the main challenges concerned with the implementation of e-government services in Libya are lack of awareness, lower levels of Internet access. Another study proposed by [10] about cloud computing in education in the Middle East and North Africa (MENA) region concluded that there are some security concerns with the viability and suitability of the cloud computing model for education such as sensitive data storage on the service provider servers. [11] Concluded that Internet penetration in Libya is far behind than other countries in Africa. [12] Stated that the new Libyan government is now working hard to provide technological infrastructure to all
universities as soon as possible. [13] conducted a study in e-learning adoption for higher education in Libya; the authors have concluded that the Libyan society is ready to accept the emergence to the e-learning model.

The research question of this paper is “What are the main factors that may affect the adoption of cloud computing in higher institute of science and technology-Ghadames. The study aimed to identify the most factors which may influence the adoption. In addition, to determine the most appropriate services that can be migrated to cloud computing in HISTG.

II. CLOUD COMPUTING IN HIGHER EDUCATION

It is expected that in the near future cloud computing will have a significant effect on educational institutions. It is considered as an exceptional alternative for educational institutions which are suffering from lack of resources and deficiency to run Information Technology (IT) systems efficiently without making much expense on computer systems and other devices.

During the past two decades, the use of Information and Communication Technology (ICT) has tremendously changed the practices and procedures of nearly all kinds of challenges within business and governance, where it started to have a strong effect in higher education, but the value of ICT is not affordable [14].

Recently the political and economical crises in Libya prevented the provision of educational services in higher education institutions. The conflict has resulted in extended closures of campuses, displacement of students and instructors, and destruction of educational infrastructure and equipment in many institutions.

The cloud computing approach has a big potential and recognition in many higher education institutions among different countries in the world. When using the cloud computing model, the higher education institutions can be more productive concentrating or research activities instead of doing the daunting job of managing and maintaining the complex IT infrastructure. So, complexity can be reduced with Cloud Computing [15].

Several education institutions in India are going to the paperless admission route, where the whole process will be managed through the cloud, including the counseling and fee payments for the classes. The technology deployments such as Smart Card readers across education institutions, university portals, student admission portals, faculty portals, student information systems, learning management system, document management systems, have already been implemented by most of the colleges recently [16]. North Carolina State University has applied the cloud model and noticeably a cost decrease in software.

When a customer needs a server space only, then “Infrastructure as a Service” is considered, however if operating system is also required, then “Platform as a Service” will be considered. Though the cloud model can bring a lot of benefits to higher education, data protection was one of the main concerns in the new paradigm [17].

III. TECHNOLOGICAL, ORGANIZATIONAL AND ENVIRONMENTAL MODEL (TOE)

Tornatzky and Fleischer developed the TOE framework in 1990 by considering three context groups: technological, organizational and environmental. Then TOE was adapted by [7]. The graph in Figure (1) shows the TOE framework which is used to examine the three context groups which are then the factors that could influence the Cloud adoption.

Performance, redundancy and relative advantage are recognized as the main technological factors, where compatibility, security and complexity were identified as the key technological endeavors which may be faced by the business. Among important organizational factors are the firm size, top management support and technological readiness. Competitive and trading partner pressure were identified as the most important environmental factors.

![Fig. 1. TOE model. (Nedey 2014)](http://example.com/fig1.png)

The TOE model serves as a complete system for identifying factors that facilitate the adoption of new technology. The adoption theory was used in the context of institutions, but it only considers the technical factors [18]. The TOE framework has an advantage over other adoption frameworks in studying new technology adoption, as it includes the main three context variables (technological, organizational and environmental). It also provides a complete approach for user adoption of technology, its implementation, predicting challenges, and factors affecting business adoption decisions to create better organizational features using the technology [5].

IV. RESEARCH METHOD

This research is a cross-sectional survey design, which used to answer the research questions of the study. The quantitative method was considered to be the approach that would yield the quantitative information. The study survey was conducted in the HISTG, Ghadames city, Libya.

In order to probe research questions “hypotheses”, the research variables have been measured. These variables were measured using five-point Likert scale, ranging from “strongly disagree” to “strongly agree (5)”. The survey instruments were reviewed and validated by experts in the field of cloud computing. Further a coefficient of Cronbach’s alpha stability is calculated using the SPSS program. The alpha coefficient for the questionnaire was “0.729”, which is considered acceptable.

The target population for this study was the institute staff, head of departments, and lecturers who are working in the Institute. Based on the interview which was conducted with the dean of the institute to identify the population of the institute, the dean said that “the institute have only 55 staff, 48 lecturers”. This population is considered as a small population, so all of staffs who are working at the institute of Ghadames are included in the study.
V. RESEARCH CONCEPTUAL FRAMEWORK AND HYPOTHESIS

By using cloud computing, institutions will be able to launch new services without managing or owning computer resources. It becomes a convenient approach to overcome capital expenditures to a limited cost of operations only. Due to fluctuating business requirements, computing resources can be stretched (scaled) and adjusted [8].

The research hypothesis can be formulated based on the TOE model that indicated in Figure (2) as follows:

The TOE model’s technology context:
HT.1) Using cloud computing enables the HISTG to have more flexible and scalable in managing IT resources.
HT.2) The less implementation complexity of cloud computing, the more adoption rate will be.
HT.3) Cloud computing is consistent with the preferred education practices.

The TOE model’s organizational context:
HO.1) Top management has allocated adequate resources (e.g. financial) to adopt cloud computing.

The TOE model’s environmental context:
HE.1) There are a number of competitors that are currently using or soon to be using cloud computing. Competition intensity is positively affecting cloud adoption (since it increases innovation pressure on institutions to stay competitive).

VI. ANALYSIS OF RESULTS

In this study a higher level person who could make the decision to adopt or not adopt the cloud computing, was invited to respond to the survey. The results showed that majority of the respondents age (42%) were between 25 to 56 years old. More than half (57%) of the respondents were female. The majority of (48%) of respondents were diploma holder. There were (45%) of the respondents working as staff.

A. Descriptive Result of Factors Influencing The Adaptation of Cloud Computing

In regards the most factor that influencing the adoption of new technology such as cloud computing in the institute, the 100 respondents in this study gave 192 multiple responses for this question. The majority 67 (34.90%) of respondents considered the support from top management as most factor influencing the adoption of cloud computing in the institute as shown in Table (I).

B. Descriptive Result of Cloud Computing Adoption

In cloud adoption the researcher included only the 48 respondents who have heard about the cloud computing. The results in Figure (3) indicate that 30 (62.5%) there is no-adoption of cloud computing in the institute and only 18 (37.5%) already adopt the cloud computing.

<table>
<thead>
<tr>
<th>Items</th>
<th>Number of response</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support from top management</td>
<td>67</td>
<td>34.90%</td>
</tr>
<tr>
<td>Compatibility of the technology to the institute</td>
<td>63</td>
<td>32.81%</td>
</tr>
<tr>
<td>Complexity of the technology</td>
<td>17</td>
<td>8.85%</td>
</tr>
<tr>
<td>Relative advantages of the technology</td>
<td>35</td>
<td>18.23%</td>
</tr>
<tr>
<td>Competitive pressure</td>
<td>1</td>
<td>0.52%</td>
</tr>
<tr>
<td>The cost implementations of adopting</td>
<td>9</td>
<td>4.69%</td>
</tr>
<tr>
<td>total</td>
<td>192</td>
<td>100%</td>
</tr>
</tbody>
</table>

Fig. 2. The TOE Conceptual Framework With The Research Hypothesis

C. Factors Influencing Cloud Computing Adoption

The result of the three main factors of the (TOE) model that may affect the adoption of cloud computing. The column labeled “percent” in the tables lists the actual percentages of the total sample who answered the questions. While the “Valid percent” is the percent when missing data are excluded from the calculations. One can observe that the percentages in the percent column are equal to the percentages in valid percent column. This can be described to as follow, all questions were answered by all respondents.

1) Descriptive Result of Technological Factors Affecting Cloud Computing Adoption

Since the technology factors concentrate on the attributes of technology innovation, and higher education cloud computing was examined under TOE framework in developed countries i.e. USA. The study was revealed that relative advantages, complexity and compatibility had the most significant contribution to variance in IT managers’ interests in adopting cloud computing [19].
With respect to relative advantages 13 (27.1%) and 21 (43.8%) of respondents strongly agreed and agreed respectively that using cloud computing enables the institute to have more flexible and scalable in managing IT resources, while 11 (22.9%) neutral, and only 3 (6.3%) disagreed as indicated in Table (II). In regards to if cloud computing is consistent with the preferred education practices, the majority, 13 (27.1%) of respondents were disagreed, 13 (27.1%) were neutral, while 11 (22.9%) and 2 (4.2%) agreed and strongly agreed respectively as shown in Table (III). In regards to know if cloud computing will be difficult to use, 7 (14.6%) of respondents reported that they are agreed, 1 (2.1%) strongly agreed, 20 (41.7%) disagreed, while 11 (22.9%) were neutral, and 9 (18.8%) strongly disagreed as shown in Table (IV).

2) Descriptive Result of Organizational Factors Affecting Cloud Computing Adoption

Regarding to if top management has allocated adequate resources (e.g. financial) to adopt cloud computing, the majority 24 (50.0%) of respondents were neutral, 11 (22.9%) disagreed, 8 (16.7%) strongly disagreed, 4 (8.3%) agreed, and 1 (2.1%) strongly agreed as shown in Table (V).

3) Descriptive Result of Environmental Factors Affecting Cloud Computing Adoption

The majority 26 (54.2%) of respondents were neutral about that There are a number of competitors that are currently using or soon to be using cloud computing, 12 (25.0%) were agreed, while 7 (14.6%) strongly disagreed, and 3 (6.3%) were disagreed as shown in Table (VI).

D. The comparison result

Since the study objectives is to identify and test technological, organizational and environmental factors that directly affect the adoption of cloud computing in HISTG. To understand and assist to what extend HISTG faraway based on finding results, we compared the outcome of HISTG with previous studies done on Saudi Arabia universities [18]. Both countries are developing countries and economically rich, which make them a potential market of cloud computing technologies. Table (VII) shows the average score of the main factors. Relative advantage has a significant and positive effect on cloud computing adoption. The average score of relative advantage is 3.92 out of 5-point scale. This means, on average, HISTG related relative advantage on agree. While, the relative advantage factor of Saudi universities is 4.26, which means, on average the universities rated relative advantage between agree and strongly. This indicates that the education institutions appreciate the value of cloud computing. The averages scores of the other factors reflect have not significant effect on cloud computing adoption in HISTG. Despite that the relative advantages factor showed a good average score.
VII. DISCUSSION

This study found that the higher institute of science and technology-Ghadames use computer facilities in the operation of its education activities. 52% of Institute's staff and lecturers said they never heard about cloud computing, and according to results, around 46.2% said the reason for that is lack of cloud computing providers who never introduce such solution to the institute. Moreover, the education level has the most important factor knowing about cloud computing, where 48% of staff and lecturers who already knew about cloud computing are mostly PhD and Master Degrees, though minority are only diploma holders.

The study highlighted that ICT transformation in HISTG was very low. This was one of the findings in previous study which concluded that Libya is still far away from utilizing ICT for modern technologies.

44.7% were neutral about that the employees are encouraging the management for cloud adoption, which can influence the decision taken by management to go for the cloud adoption to enhance education in HISTG. The study found that 43.5% agreed that cloud is advantageous for the institute. This concluded that relative advantage has significant and positive effect for adopting cloud computing. The particular major advantage is lightness. In other words, shortening the development time of information systems and performing task more rapidly.

41.7% disagreed that cloud adoption is difficult. This result contradicts with previous study conducted by which concluded that complexity was identified as one of the most significant factors which may affect negatively cloud computing adoption. This could be due to their lack of knowledge about cloud computing, as the availability of a reliable Internet connectivity is one of the vital requirements of cloud adoption. 22.9% agreed that cloud is compatible with the institute. Thus compatibility has not significant effect on cloud computing adoption. This result differs from previous research [20] and accord with [21]. This mixed result may be ascribed to that institutions have not yet noticed major difference between cloud and in-house computing. Namely, the result may mean that cloud computing is still in its early stage of adopting.

The results of study showed also that 50.0% were neutral and they have no idea if top management is planning for cloud adoption and that budgets are already allocated. Whereas 22.9% said it is not correct as the country is currently has an economy crisis. So, top management support has not significant effect on cloud computing. The average score id 2.56 out of 5-point scale, which means, on average has natural position. The passive position of management towards cloud computing might be because of unfledged implementation of the cloud computing in HISTG. Finally, competitive pressure has not significant effect on cloud computing adoption. The average score of this factor is 2.92 out of 5-point scale, on average, the factor is natural. It seems there is not any form of competitive pressure. This may be attributed to that HISTG have not yet adopted cloud computing services.

The study also indicated that the institute has a capable staff who can manage the cloud. That is because the IT technical staff has the knowledge or the ability to learn such new technology.

VIII. CONCLUSION

In this study, we have tried to identify factors that influence the cloud adoption in higher institute of science and technology-Ghadames using the TOE model, but due to the current political crisis in Libya and Institute specifically, we can say it's hardly difficult to adopt cloud computing in the near future. It was shown in study results that the most important factor which may affect smooth cloud adoption is the complexity, which need more support and cost. The study also showed that the relative advantage has a significant and positive effect on cloud computing adoption.

With respect to comparison analysis between HISTG and education institution in Saudi Arabia, only few institutions have adopted cloud computing services.

The results will offer cloud computing providers and consumers valuable insights about the critical factors that affect the adoption of cloud computing.

The study though has certain limitations, firstly, where the sample consisted of respondents from only one institute; thus, the findings had to be interpreted with caution. Secondly, the data collected was based on self-reporting methods, and may therefore be subject to bias.

IX. FUTURE WORK

This paper presents cross-sectional survey design, which used to answer the research questions of the study. However, limited essential factors were examined for better understand the shift in cloud computing adoption.

This research study was the first done in the context of cloud computing in Libya, as stated before, so, its recommended to do more research on the subject and bring more new ideas to fit the environment of the higher education in Libya, hence make cloud computing as one of the modern solutions to consider.

ACKNOWLEDGMENT

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REFERENCES

<table>
<thead>
<tr>
<th>Factors</th>
<th>Mean HISTG</th>
<th>Mean Saudi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Advantage</td>
<td>3.92</td>
<td>4.26</td>
</tr>
<tr>
<td>Competitive Pressure</td>
<td>2.90</td>
<td>3.48</td>
</tr>
<tr>
<td>Complexity</td>
<td>2.40</td>
<td>2.44</td>
</tr>
<tr>
<td>Compatibility</td>
<td>2.67</td>
<td>3.89</td>
</tr>
<tr>
<td>Management Support</td>
<td>2.56</td>
<td>3.47</td>
</tr>
</tbody>
</table>

TABLE VII. THE COMPARISON RESULTS OF THE MEAN FOR CLOUD COMPUTING BETWEEN HISTG AND SAUDI ARABIA


