Cloud Computing Awareness among Practitioners in Yemeni Universities: An Exploratory Study

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Abstract:

Cloud computing is a new IT model adopted by many higher education institutions to gain competitive advantage. This study aims to explore the awareness of cloud computing technology among higher education institutions in Yemen. Using academic and administrative staff as the sample, the participants were asked to show their level of awareness of this emerging technology, the extent they utilize the technology, and to give their opinions about the advantages, challenges, and barriers of using this technology. The findings show high level awareness of cloud computing importance for higher education institutions. Besides, the universities are ready to adopt this technology when they can overcome the most challenges which are cost, Internet speed, privacy, and lack of knowledge on how to apply this technology.

Keywords: Awareness, Cloud computing, Higher education, Yemen.

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الوعي بتقنية الحوسبة السحابية بين منتسبي الجامعات اليمنية: دراسة استكشافية

الملخص:

الحوسبـة السحابيـة هي نموذج جديـد لتكنولوجيا المعلومات اُعتمـد ﭬ العديد من مؤسسـات التعليم العالي للحصـول علـى ميزة تنافسية. تهدف هـذه الدراسة إلى استكشـاف الوعي بتكنولوجيـا الحوسبة السحابية ﭬ مؤسسـات التعليـم العـالي ﭬ اليمـن. تم اجراء البحث علـى عينة مـن الأكاديميين والإداريـين، وطلب من المشاركـين إظهـار مستوى وعيهم بهـذه التكنولوجيـا الناشئة، ومـدى استخدامهم لهـذه التكنولوجيا، وإبداء آرائهم حول المزايا والتحديات والعوائق التي تحول دون استخدام هذه التكنولوجيا. أظهرت النتائج مستوى عال من الوعي بالحوسبة السحابية بين المستجوبين. إلى جانب ذلك، فإن الجامعات على استعداد لتبني هذه التكنولوجيا عندما تتمكن من التغلب على معظم التحديات التي أهمها التكلفة، سرعة الإنترنت، الخصوصية، وقلة المعرفة بكيفية تطبيق هذه التكنولوجيا.

الكلمات المفتاحية : الوعي، الحوسبة السحابية، التعليم العالي، اليمن.

1. Introduction:

Cloud computing is a new computing paradigm in information technology (IT) and becomes one of the most important research topics. It has many properties that provide benefits to individuals, businesses and universities. Thus, it is a hot topic in information technology literature. Many professionals consider cloud computing to be the best solution to improve the growth of companies in each sector [1].

According to [2] cloud computing refers to "data transfer and software from local servers to the Internet, providing users with the ability to access and share information at any time, from multiple devices".

Simply put, it can be said that cloud computing offers all services such as applications, infrastructure, and platforms as a service over the Internet.

Many studies have been conducted for cloud computing adoption in different fields. In [3], authors presented a comparison of two studies conducted in Slovenia and Croatia micro enterprises to measure cloud computing awareness. They focused more on the characteristics of the micro enterprises and their owners. Reliability, security and performance were found as the most important characteristics of cloud computing in which they cloud represent a good business opportunity for micro enterprises. Nevertheless, this study overlooked other important characteristics related to other aspects such as users, services and infrastructure.

Cloud computing has many benefits in educational institutions such as reducing IT costs while increasing productivity, availability, and reliability. This technology is a promising solution for many challenges facing higher education institutions in developing countries [4].

Internationally, several researches have been conducted to study cloud computing adoption in higher education institutions [5]. Roger's utilized Diffusion framework to propose a model for cloud computing adoption in higher education institutions in India. The study considered cloud computing as a proper fit for the requirements of the higher education sector in particular of scarcity of funds. However, this study only provided a theoretical framework without any empirical evidence [6].

Gital and Zambuk [7] explored the potential of the application of cloud computing in higher education in Nigeria and highlighted its benefits and expected limitations. This study was lacking to a theoretical framework

supported by empirical evidence. In [8] authors proposed an adoption strategy of cloud computing in higher education in Romanian universities which includes five stages. The study concluded that the starting point for choosing a suitable cloud model are data analysis and main activates within universities. The study also emphasized on special security requirements of higher education and the available cloud solutions as well. However, this study needs more investigation for the level of acceptance and the implementation effects of cloud computing. The advantages and limitations of cloud computing in Ethiopian higher education were discussed in [9]. In addition, a hybrid cloud computing framework was proposed. The findings show that cloud computing is the best ICT utilization mechanism. Furthermore, the proposed framework forms the road map for the implementation of cloud based teaching-learning and service delivery ecosystem. Using a survey, study, [10] revealed that cloud computing tools are most frequently used by librarians in India central universities in their daily library and business services. The results have shown that cloud computing play an important role in librarians work.

Using a survey, [11] addressed the utilizing of cloud computing in higher education in Kingdom of Saudi Arabia. The findings showed that professionals working in the industry and academia strongly support the proposal to improve cloud computing in higher education.

In the literature, a few studies have been conducted on cloud computing technology in higher education institutions in Yemen. One of them is the study conducted by Samah Bagish [5] which focused on the students› awareness of cloud computing by investigating their opinions about using cloud computing collaboration applications. The author suggested recommendations for education institutions to increase awareness and knowledge of cloud computing. The study is limited to only one college at Aden University. There is therefore a need for further investigation of the awareness from a large population to make more generalized findings.

The other study [12] discussed the possibility of using cloud computing at Taiz University computer center to improve work efficiency. A hybrid cloud was proposed to keep pace with current information and to have better control over the IT assets and configuration in computer center.

2. Background:

The National Institute of Standards and Technology (NIST) [13] defines cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".

Based on NIST definition, cloud computing has five main characteristics, four deployment models, and three service models as shown in Figure 1.
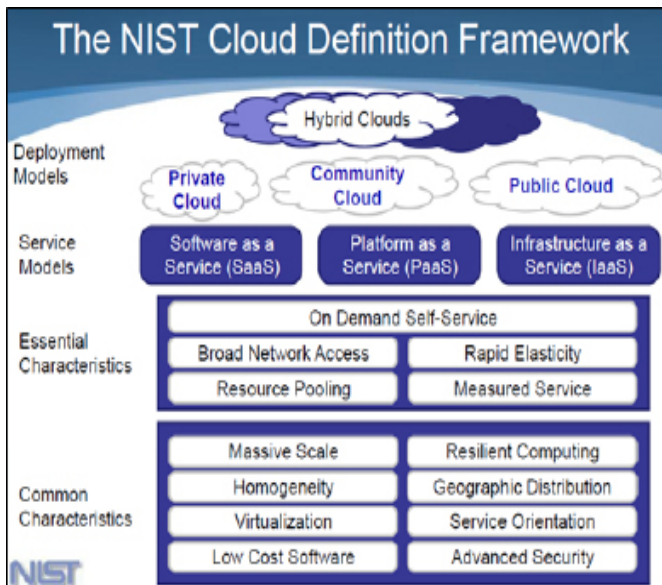

Figure (1): NIST cloud framework [13]

The five essential characteristics of Cloud computing are:

- On-demand self-service in which the computing services, such as processing, server, and storage, can be used as needed.

- Broad network access in which resources are available and can be accessed through any device.

- Resource pooling: The vendors providing a collection of real or virtual resources such as storage, processing, memory, and network bandwidth to users as a single location in a dynamic manner.

- Rapid elasticity and scalability: Users request different services and resources as much as they need at any time.

- Measured service: Resource usage can be monitored, controlled, and, optimized. This service such as storage, processing, memory, and network bandwidth.

The three models of cloud computing are software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

In SaaS users can use applications available through the browser interface, but they cannot control any of the servers, hardware or operating systems. The user can run the services without downloads or installations required, only uses the services and some settings, such as traditional desktop-based applications that are introduced as a service [13-15].

The PaaS is a model where capability is provided to the user to build and deploy applications using the programming languages, libraries, etc... All these tools are provided without a need to download or install into the user's machine [6, 13] .

The IaaS gives the user's ability to handle and manage the infrastructure of processors, network storage, and network equipment for the deployment and operation of the software, as well as operating systems [14].

The cloud computing deployment models are:

- Private cloud: the cloud infrastructure dedicated to one organization and its ownership, use, and management by the same organization or third-party [6].

- Public cloud: the infrastructure is open to the public, managed and owned by a government, commercial or a combination of them.

- Community Cloud: the infrastructure of this model is dedicated for a group of users and organizations, having shared concerns such as universities and non-profit organizations.

- Hybrid cloud: is a combination of two or more of the previous models (private / community / public). The organizations use this model to improve their performance and increase the efficiency of their core activities [16].

3. Research methodology:

In this research, an exploratory study is conducted and a self-administered survey questionnaire is used to collect the data. The questionnaire questions were adopted from previous studies related to cloud computing adoption and awareness in different sectors.

The questionnaire consists of 34 questions cover four parts. The first part was dedicated for profiles of respondents demographic such as gender, age, specialization, level of study, among other. The second part was for assessing respondent's awareness and understanding of cloud computing services and models. This includes questions that measure the extent to which the respondents have knowledge about cloud computing concepts, services, models, and providers. The third part was to measure the deferent cloud computing services usage by the respondents. The advantages, challenges and barriers of the cloud computing were measured in the last part of the questionnaire. The sample of this study was formed from the staff at some public and private Yemeni universities in the capital of Yemen, Sana'a. A total of 108 respondents from 10 public and private universities participated in the questionnaire. Table 1, shows the demographic profile of respondents.

4. Data analysis and finding:

The number of participants in the questionnaire amounted to 108 respondents distributed around different specializations. The majority of the respondents (58%) are IT professionals while the rest are distributed among the other specializations, namely, engineering (13%), medical sciences (2.9%), administrative and accounting (10%), human sciences (13%), and others (6%). For this study, 35% of the respondents graduated from a college or a university and got a diploma (6.50%) or a bachelor (28.7) degree. The majority of respondents (66.7%) have postgraduate degrees with a distribution of 38% for master degree and 26.9% for PhD degree. More than 60% of respondents are academic and 39.8 % are administrative. Table 1 shows the demographical characteristic of the respondents.

Table (1): Demographic profile of respondents

Major characteristics		Frequency (F)	Percent (%)
Specialist	IT	58	53.70%
	Engineering	15	13.90%
	Medical Science	3	2.80%
	Administrative & Accounting	11	10.20%
	Human Science	14	13%
	Others	7	6.50%
Education Level	Diploma	7	6.50%
	Bachelor	31	28.70%
	Master	41	38%
	Doctorate	29	26.90%
Work Type	Academic	65	60.20%
	Administrative	43	39.80%

For the respondent›s awareness, Figure 2 illustrates that the majority of respondents (87%) have high level of awareness about cloud computing , while the minority (13%) have a few level of awareness of cloud computing.

As reported in Table 2, E-mail, cloud storage, and office applications represent the services with the highest usage among the respondents (76.9%), (81.5%), (46%) respectively. The realistic reason behind this is that E-mail, for instance, is an easiest and most popular method for communication between people.
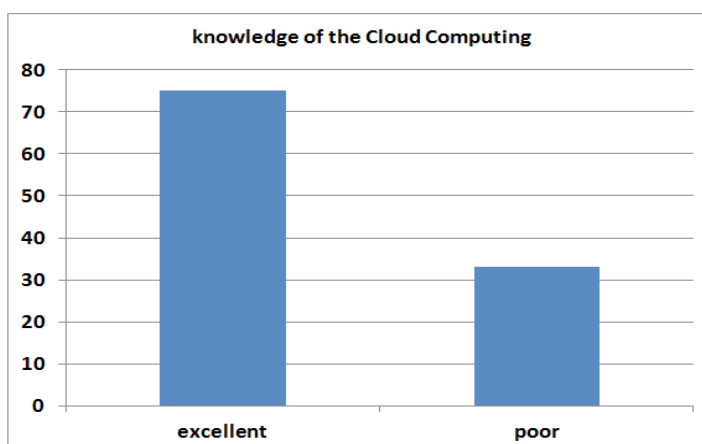
Figure (2): Respondents knowledge about cloud computing

As for the rest of the services, they form less than 50%. This could be due to most respondents are less interesting on such services.

Table (2): Cloud computing services used

Services used	Frequency (F)	Percent (%)
E-mail	83	76.90%
Cloud storage	88	81.50%
Office applications	50	46.30%
Cloud music services	28	25.90%
Cloud Operating Systems	28	25.90%
Otherwise	6	5.60%

Although it is not tabulated here, a total of 53% of respondents use cloud computing services daily, while 21% use them weekly and this shows significant importance of cloud computing services for them. Also findings show that most services used are those coming from Google and Microsoft since these two companies are considered the leader in cloud computing from respondents view.

To deeper understand the adoption of cloud computing, the respondents were asked to rank several expected benefits they will gain in case of the adoption of cloud computing technology.

Figure 3 elaborates the most important benefits from the respondents perspectives in which cost, data access, availability, and existing infrastructure of providers are seen the most important ones followed by flexibility and scalability, secure storage, and pricing model.
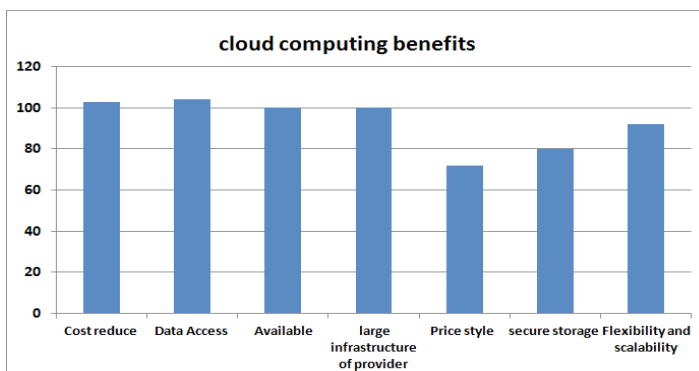

Figure (3): Respondents opinion of cloud computing benefits

With regard to the respondents› opinions about the main challenges encounter cloud computing technology adoption illustrated in Figure 4. The Internet speed, privacy and confidentiality of data, and lack of knowledge about cloud computing are the most important challenges that may influence on adoption decision. As mentioned previously, the respondents confirm on their concerns about the Internet service availability and data privacy since there is a lack of regulations and government laws that protect user data privacy and leverage confidentiality.
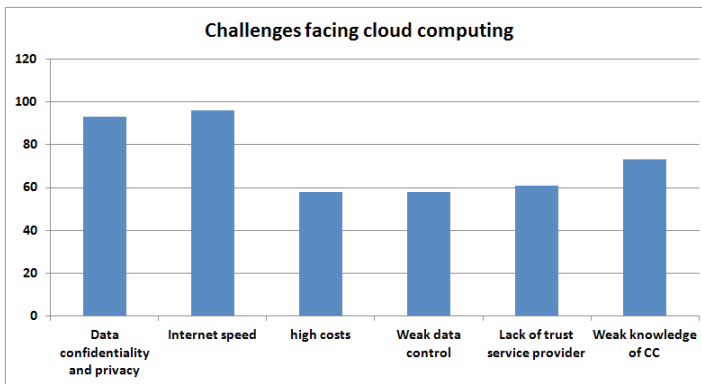

Figure (4): Respondents opinion of challenges facing cloud computing

Figure 5, illustrates the barriers for cloud computing adoption from respondents perspectives. The most important barrier to adoption is the Internet speed followed by the security and privacy, and the potential attack on data. This actually emphasizes on the importance of providing Internet service anytime and anywhere, and guarantees data access and maintaining privacy.
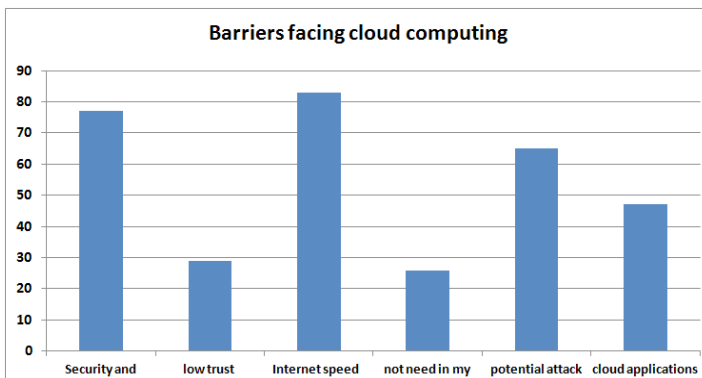

Figure (5): Respondents opinion of barriers of cloud computing

The findings also show that 43% of respondents believe that their universities recognize the importance of cloud computing and they are highly ready to adopt this technology. In addition, 31% of them have a mediate readiness to adopt cloud computing. While the rest of the respondents either have low readiness to adopt cloud computing or have no idea about it, Figure 6 illustrated it. This gives the researchers a motivation to go further to investigate the most important factors that will lead to the adoption process and usage of the cloud computing technology in the higher education sector.
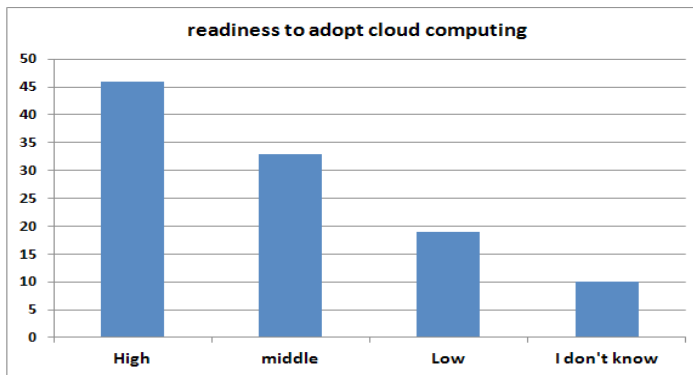

Figure (6): Respondents opinion of their universities' readiness to adopt cloud computing

5. Discussion:

The study aims to explore the extent to which higher education institutions in Yemen have awareness about cloud computing. The results discussed above revealed that cloud computing services such as E-mail, cloud storage, and office applications are highly used among higher education institutions and this is due to the ease of use and the importance of these services. With regard to the extent to which such services are being used, the results indicate that higher education institutions use them daily to facilitate their work. The results elaborates that higher education institutions believe that they will gain more benefits from cloud computing adoption through cost reduction, data access, availability, and existing infrastructure of providers. This could be interpreted from two main views: (1) most universities in Yemen lack to enough budgets to invest in cloud computing technology; (2) the extent to which Internet service is available in Yemen still in its low level in contrast to developed countries. In contrast, higher education institutions are very

concern about privacy and confidentiality of data, internet speed since there are a lack of regulations and government laws that protect user data privacy and leverage confidentiality. Besides, the ministry of telecommunication in Yemen suffers from weak infrastructure of ICT.

In general, results show that majority of higher education institutions recognize the importance of cloud computing and they are ready to adopt this technology. This is may be due to the great benefits of cloud computing that can be gained in case of adopting this technology.

6. Conclusions:

The objective of this study is to explore the level of awareness of cloud computing among higher education institutions in Yemen. Since there is a very slow adoption rate of cloud computing among Yemeni universities, there was an urgent need to obtain the academic and administrative perception, as they are the most important targeted respondents. This study also investigates the extent of utilizing the technology, and to get respondents opinions with regard to advantages, challenges, and barriers of cloud computing technology. In order to achieve the objectives, this study employed questionnaire survey in private and public universities in the capital of Yemen, Sana›a.

The findings show that the majority of respondents have high level of awareness about cloud computing and therefore, the universities they are working in, are ready to adopt cloud computing once they are able to overcome the challenges and barriers posed toward this technology. It is perceived that E-mail, cloud storage, and office applications are most commonly used services. This confirms that the staffs at universities are more interested with these services due to the daily needs for using them to facilitate the communication among the different functional units. Furthermore, it is confirmed that users sees the cloud computing as a beneficial technology in cost reduction, data access availability, and utilizing of providers infrastructures. This may exempt universities from allocating large amounts of money to invest in information technology required for their work especially when they have insufficient budget.

The problems of internet speed and privacy places the government in charge of enacting legislation that guarantees user›s data privacy and confidentiality. Also, Internet service providers should look for effective solutions to improve the Internet speed among which increase the opportunities of using cloud

computing services. Since this study is merely an exploratory study, there is a need for further study to investigate the determinants of cloud computing adoption in higher education institutions. Further research for the selection of suitable models of cloud computing deployment may be essential for higher education institutions. As this study also only focuses on higher education, another study with larger scale of respondents from different sectors may be beneficial to get more insights regarding the adoption of this technology.

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