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Prioritizing Adoption Factors of Cloud Computing: A case of Ministry of Higher Education in Iraq

Haider Abdulkadhim Alwan [a], Mahadi Bahari [b]

[a] *Federal Board Supreme of Audit, Iraq. Dr.HaiderAbdulkadhim@gmail.com*

[b]*Faculty of Management, Universiti Teknologi Malaysia, Johor, Malaysia. mahadi@utm.my*

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ABSTRACT

Cloud Computing is one of the latest revolutions in information technology that influences many sectors in many governments. Cloud computing is a model for providing resources for storage and communication based on the service as quickly as possible, that is virtually applied through internet access. Despite the concern shown by many countries in adopting cloud computing, not many researchers have shown what the most desirable factors are that influence key players in public sector to allow them to decide on cloud computing adoption. The existing researches indicated other areas such as accepting the cloud computing service in government organizations, establishing the architecture of cloud computing, and integrating the cloud computing services. Thus, the study has examined to prioritize adoption factors that have been considered the most desirable ones in effecting public sector adoption cloud computing by conducting a web- based survey in the Ministry of Higher Education in Iraq. From the results, the top management support, cloud strategy, IT infrastructure, compatibility, external expertise, and internal experts, are the most important factors for Iraqi government organizations to adopt cloud computing while complexity, trailability, competitive and cost factors are specified as the minor factors.

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1. Introduction

Previous studies have confirmed that Cloud Computing is a key component for electronic government (e-government). For example, the United Kingdom government delivered its technologies plan in 2011 that covered the cloud networking concept and involved reducing technologies cost for governments, and enhancing the use of data center infrastructure [1]. Another example, Australian government adopted Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) cloud computing in 2013 to migrate data set on the data.gov.au to the public Amazon cloud. The govspace.gov.au and data.gov.au websites were migrated onto a private cloud[2]. Cloud based networking provides on-demand self-service. Computing capabilities, such as network storage , server and processing time are

∗Corresponding author **Haider Abdulkadhim Alwan**

Dr.HaiderAbdulkadhim@gmail.com

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provided automatically as needed [3]. These Cloud computing benefits show it's vital role in e-government projects.

However, in Iraq, just like in other developing countries, cloud based e-government services have either failed or stalled to meet their objectives because of additional obstacles such as lack of IT expert [4] and electricity shortage [5] and problems with internet connection [6] amongst others.

Existing studies on cloud computing adoption do not show all success factors in the whole stages of adoption of cloud computing. They are only concerned with a small part of the adoption process such as the architecture of cloud computing [7, 8], the integration of cloud computing [9], the citizens' acceptance of cloud computing[10]. Furthermore, existing studies on cloud computing adoption have not clarified what the most important factors are that influence key player in government organizations to allow them to decide on cloud computing adoption. Thus, this work aims to identify the success factors that influence in the whole cloud adoption life cycle and to show which factors should be given the highest priority.

This article has been structured as follows: Section two describes the related literature on cloud computing adoption. Section three explains the research methodology. Section four is concerned with the findings and discussion from the study undertaken. This is followed by the conclusion and future work.

2. Related Literature On Cloud Computing Adoption

This section will review the literature on cloud computing adoption and it is divided into three parts. The first part gives an overview of the cloud adoption stages. Part two has reviewed the state of the literature on cloud computing studies. Part three looks at the common factors for cloud computing adoption.

2.1 Cloud computing adoption stages

There are nine stages of cloud adoption [11] as shown in Figure 1.The first stage is the pilot project which refers to the early experimentation activities such as providing the skills for the technical staff, and test evaluation of the technology. Once a pilot project is done, this learning's should be formulated into a formal cloud strategy roadmap (stage two). A cloud strategy roadmap is a guide tool that will assist in how organizations adopt the cloud [12]. It is a virtual communication tool including tasks with deadlines that will enable the successful adoption of cloud computing by organizations [13]. The third stage is concerned with cloud modeling and architecture. Cloud modeling and architecture force the explicit definition of business needs and then establish what cloud technical partners and resources models best suit the business requirement [14]. The fourth stage is the planning of cloud computing. This stage comprises steps for cloud implementation as well as a training schedule for preparing the workforce for cloud computing[11]. In the fifth stage, the organizations go "live" with their cloud service as defined in the cloud strategy roadmap. When cloud computing goes live, more applications are built natively to exploit cloud computing (stage six). In the seventh stage, integration, portability and interoperability aspects must be take into account and they must be addressed upfront during the cloud strategy roadmap, as well as during vendor selection and contract negotiations. Once cloud project is working efficiently, delivery organizations and business units can effectively cooperate on IT solutions and business via the cloud service (stage eight). Lastly, cloud will be complete and ready to be used as the main way of working in this enterprise and making it a part of the organizational culture (stage nine).

Previous studies are only concerned with a small part of the adoption lifecycle, as explained in the next section.

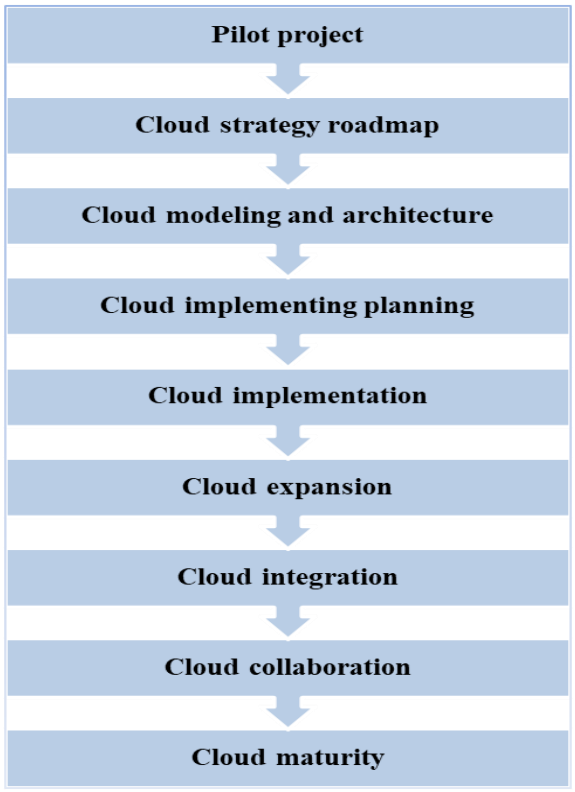

Figure .1. Cloud computing adoption stages [11]

2.2. Cloud computing adoption studies

Many prior studies such as [7, 8, 15-20] deals with the architecture of cloud computing. For instance, Johnson and Qu [20] proposed a model to evaluate and assess the cloud service provider through several aspects including business economics, and other business requirements such as security and availability. Huang, et al. [16] propose a guaranteeing quality of service (QoS)-aware service method in order to attain cloud networking service composition with end to end performance guarantee.

Some studies [10, 21-27] are concerned with the acceptance of cloud computing service in government organizations. For instance, Mohammed, et al. [22] proposed a model based on two theories, the Fit-Viability Model and Diffusion of Innovation. Their findings affirm that adopting cloud service needs to consider fit and viability aspects with their factors. The fitness of cloud computing to e-government tasks that influenced by issues such as security, trialability, and compatibility. While the viability aspect is influenced by technological readiness (such as IT infrastructure, and IT skills) and economic issues such as asset specificity.

Other studies such as [9, 28-33], deal with the integration of the cloud computing. For instance, the study by [33] confirmed that integrating cloud computing with the Internet of things (IoT) is mandatory or very necessary. They proposed algorithm model to address security issues of the integration of Internet of Things (IoT) and Cloud Computing.

Existing studies are only concerned with a small part of the adoption lifecycle. Furthermore, existing studies on cloud computing adoption have not shown what the most important factors are that influence key players in government organizations to allow them decide on cloud computing adoption. For that purpose, the common factors

in the whole cloud life cycle are presented in the next section.

2.3. Factors influencing cloud computing adoption

Cloud computing adoption is a complex issue that involves organizational, technological and environmental divisions [34] . Organizational factors are in regards to top management, availability of budget, and qualify of human resources. For instance, Adiyasa, et al. [35] clarified that cloud computing adoption can be negatively influenced by the lack of top management support. Similarly, Oliveira, et al. [36] stated if top management does not show full support and commitment toward cloud service, users would not accept such a system.

Meanwhile, Technical factors refer to the technological infrastructure, complexity, integration with in-house system, and so forth. For instance, [34] and [36] stated that the lack of compatibility with proprietary software will negatively influence cloud-computing adoption. Gangwar, et al. [10] also mentioned that the integration must be complete and coherent with cloud computing and its parameters in order to ensure compatibility and combined interoperability.

The environmental factors, on the other hand, are related to external expertise, and competitive pressure. For instance, Yoo and Kim [37] explained that the most important vendor selection criteria is the skill and experience level. A highly skilled vendor will reduce the strain on the IT staff and users in the organization during the cloud adoption. Similarly, [38] mentioned that the good reputation of cloud providers will increase the organization's confidence towards cloud- based network and will give them a positive motivation to use cloud services. As for the competitive pressure factor, [10] indicated that many organization encounters pressure from competitors to adopt new technologies. Some organizations are compelled by this pressure to implement cloud computing technology, which offers them additional business facilities and improved operational efficiency.

Table-1 shows organizational, technical, and environmental divisions with their factors in the cloud computing studies. Factors such as top management support, internal expertise, cost, and cloud computing strategy were considered as organizational factors whilst IT infrastructure, compatibility, complexity and trail ability were considered as technical factors. In addition, external expertise, and competitive pressure were considered as environmental factors.

Table 1. Common Factor in cloud computing adoption

Context	Description	Success factors	Reference
Organizational	Evaluating the organization's ability as a whole and the backing of top management	Top management support	[35, 39-42]
		Cost	[38, 43-47]
		Internal experts	[38, 39, 42, 46, 47]
		Cloud implementation strategy	[34, 35, 46, 48]
Technological	Assess the organization's current technologies' level of readiness.	IT infrastructure	[40, 46, 47]
		Compatibility	[39, 40, 42, 47, 49, 50]
		Complexity	[35, 39, 40, 47]
		Trailability	[39, 51, 52]
Environmental	Assess the state of around especially External expertise and Competitive pressure	External expertise	[38-40, 47]
		Competitive pressure	[10, 35, 53]

Ten (10) common factors have been identified from the existing studies that one should be considered when adopting cloud computing. The10 factors were then categorized to the organizational, technological and environmental divisions (see table 1). Table 1 just presents a list of the factors and does not mention which factors should be prioritized while adopting cloud computing systems. Therefore, it is important to rank those factors for allowing the key players in the governments' originations to decide on cloud computing adoption.

3. Research Methodology

A Web-based survey has been selected as the research method. The aim of a web-based survey is to allow the study to cover a wide geographical area while incurring minimum cost and time. Google Form instrument was used to design and develop the web-based survey. The survey questionnaire is made up of two sections: the first section is related to demographic purpose. Section two is made up of 10 questions to rank the success factors of the adoption of cloud computing. A five-point Likert scale, with "strongly not important=1" to "strongly important=5", was used to score these questions. Data was arranged and analyzed using Microsoft Excel.

The researcher was very aware of the importance of thoroughly testing the instrument before releasing the full survey. The testing process aimed to get early feedback about the instruments used. The survey was sent to two experts (A senior programmer in the Federal Board Supreme of Audit, and an IT manager from Musel University) to validate and some comments provided by them. The comments were discussed and revisions were made.

The Ministry of Higher Education (MOHE) in Iraq is selected for sampling because they have already adopted cloud computing. After three weeks (3-24 March 2020) for feedback, the researcher has received about 197 respondents. Then, the study was filtered omitting 6 respondents (e.g., who failed to complete all the questions in the questionnaire) leaving about 191 respondents who were eligible to provide data for the study.

4. Finding and Discussion

Table 2 provides the participants' demographic profile. 39% of respondents were IT specialists such as data administrators, programmers, and 33% were lecturers. The other participants were administrative employees or related areas. The average number of years of experience for the participants was about ten years.

Table 2. Demographic profile of all participants

Attribute	Category	Frequency	%
Gender	Male	123	64
	Female	68	36
	Total	191	100
Position	IT specialist	74	39
	Lecturers	63	33
	Administrative	37	19
	Others	17	9
Experience	<5	28	15
	5-9 years	44	23
	10-15 years	102	53
	>15	17	9

From the organizational dimension, the top management factor has the highest effect in adopting cloud computing in the MOHE as shown in Table 3. Top management can affect the other success factors to some extent. Having top management prioritize the cloud-based networking project, commit to provide adequate human and financial resources to the implementation, communicate the vision of the organization on introducing the cloud networking project, establish polices, rules and job responsibilities for its new application is vital to the cloud project's success. Also, the most important to respondents was the strategy and roadmap of cloud computing. The cloud strategy factor (4.405) is the second highest priority. Government organizations must prioritize how information is handled with cloud networking implementations and then also guarantee that proper guidelines and rules are in place in order to regulate the usage of such a technology. While the internal expert factor is in the neutral position (mean 3.495). The dependence of the Iraqi government on trading partners for their IT solutions could explain this result. The empirical findings also found that the cost factor (mean 2.552) has the lowest priority. This may be the reason the cost of cloud -based networking is low compared to traditional computer technologies or the responsibility to update software and applications belongs to the cloud provider and it lowers software upgrade cost of an organization.

Table 3. Analysis of success factors influencing Cloud Computing adoption

Context	Factor	The weights (Mean)	Priority
Organizational	Top management support	4.721	1
	Cloud strategy	4.405	2
Technological	IT infrastructure	4.306	3
	Compatibility	4.288	4
Environmental	External expertise	4.108	5
Organizational	Internal experts	3.495	6
Environmental	Competitive	2.892	7
Technological	Complexity	2.726	8
	Trailability	2.568	9
Organizational	Cost	2.552	10

The second most important for adopting cloud-based networking in the MOEH is the technology dimension. From the results, the IT infrastructure factor with (4.306) is the third highest, and the compatibility (4.288) is the fourth highest as shown in Table 3. This aligns with previous studies that the governments in Iraq are still facing some difficulties in communicating and sharing data across originations, this is due to the bad telecommunication capabilities, poor quality data as well as the incompatibility of the system [4]. Therefore, considering telecommunication infrastructures, and system compatibility factors when adopting cloud services are a must be in the Iraqi government context. Other technical factors (i.e., complexity, and trailability) can be considered as minor success factors when deciding to adopt cloud computing.

Regarding the environmental dimension, the respondents' responses towards the importance of the external expertise factor as suggested by [38]. The external expertise factor (4.108) was the fifth highest priority. The decision maker will benefit from a vendor to take advantage of the best options, avoid common pitfalls or overcome any resistance to change from the staff who are not IT savvy and lack confidence in the use of a cloud service. While the competitive pressure factor (2.892) was specified as a minor success factor.

5. Conclusion and Direction for Future Research

This research has examined to prioritize of adoption factors that have been considered as the most desirable ones in influencing public sector to adopt cloud computing through the use of web based surveys in MOHE in Iraq. The ranking of the factors in MOHE uptake from two perspectives: user and IT staff. While a larger sample size might be necessary to fully generalize the findings, the results nonetheless offer insightful information about the factors that the Iraqi government organizations should take into account before adopting cloud computing.

The future work of this study is to use a qualitative research approach utilizing case studies to give a complete understanding of cloud computing adoption decision-making in the Iraqi government.

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