



Empirical Evaluation on Cloud Computing in Oil and Gas Industries in Bahrain

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Abstract. Cloud computing has gained importance in Bahrain with the introduction of government “Cloud First” policy. This study investigates factors that affect Cloud computing technology adoption in oil and gas industry in Bahrain. Technology Acceptance Model (TAM) is used with Theory of Reason Action (TRA). Perceived Ease of Use (PEOU), Perceived Usefulness (PU), and Confidence Level (CL) of users investigated. Convenience sampling, sample size of 89, by a questionnaire survey .IT employees from three selected companies: Tatweer Petroleum, Bahrain Petroleum Company (BAPCO), and Bahrain National Gas Company (BANAGAS). Multiple Regression analyses used. Findings indicate Agility and Trust affect Cloud computing technology adoption. Managerial implications; give insights to managers on adding or improving Agility as a feature. Agility of the technology has cost implication and schedule reduction to organization. Trust as being an important direct predictor of technology adoption. Limitations: small sample size, cross-sectional study, and no interactive effects examined. Recommendations: larger sample size, comparative studies, longitudinal studies, include other factors such as accessibility, cost, and top management support.

Keywords: Cloud computing, Technology Acceptance Model (TAM), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Confidence Level (CL).

1 Introduction

In Bahrain, the oil and gas sector has contributed to 18.6 per cent share of Gross Domestic Product (GDP), being highest contribution towards the GDP of this country. With the current developments that requires latest technology to achieve competitive advantages [1] and with the frequent low oil prices, oil and gas companies are under tremendous pressure to maintain revenues. The reduction in oil demand causes a slow-down in Bahrain’s economy. Therefore, it’s a must for oil and gas companies in Bahrain to adopt a new technology that result in a reduction in the cost to maintain the same quality or better in their Information Technology (IT) operating system. Confidence Level (CL) as a variable is often not empirically validated in many studies in technology

adoption but only in internet banking where Confidence Level (CL) of users leads to the adoption [2]. The main objective of this paper is to evaluate the relationship between three factors that are Perceived Ease of Use (PEOU), Perceived Usefulness (PU), and Confidence Level (CL) of users on Cloud computing technology adoption in oil and gas industries in Bahrain. Technology Acceptance Model (TAM) is used to evaluate the effect on Cloud computing technology adoption. Data will be collected through a questionnaire survey whereby respondents are engineers, managers, and Information Technology (IT) experts in the oil and gas industry in Bahrain.

2 Literature

Technology acceptance can be defined as “the positive decision to use a particular technology or an innovation” [3]. However, technology does needs to be accepted and adopted by business organizations. Technology adoption involves several parties such as managers and technical employees. This should happen before certain technology been physical occurrence in the organization. There are some factors that affect the managers and technical employee decision and intention to adopt new technology such as: acceptances and contributions, employee attitudes, knowledge and skills of employees, perception, management innovativeness, and cost benefits. The decision to adopt new technology is affected by other factors such as consultants, business partners, providers, and users [4]. Technology acceptance is determined by the user believing that using that technology will increase job performance and have less effort. User acceptance of technology means user are willing to adopt this technology and gain benefits [5]. Technology adoption is the stage where decision is made about adopting the technology. In this stage the technology should be adopted by taking care of cost benefits, knowledge and skills of employees, and employee attitudes [4]. Therefore, technology acceptance is related to the individual user while technology adoption is related to organization wide process.

2.1 Cloud Computing Technology

Cloud computing provides use of software/hardware with no big capital asset and provides fast access to services and applications that can be used without interaction of Cloud service provider [6]. Cloud computing can be defined as an evolution of adoption of multiple technologies including virtual computing, network computing, independent computing, effectiveness computing, and software services [7]. Cloud computing is defined as a type of technology which provides shared resources and services via Internet. Cloud computing technology is used to provide the service to the users based on user demand over the internet. This technology will decrease the cost of hardware and software services [8]. Advantages of Cloud Computing Technology are agility, scalability, decrease in cost, software/hardware automatic upgrades, and flexibility [9].

2.2 Factors Influences Technology Adoption

Confidence Level (CL) of users is one of the biggest challenges that Cloud computing technology faces is the issue of user confidence [10]. This is the prime motivator/inhibitor of adoption of Cloud computing technology. This refers to the lack of appropriate procedures and policies to ensure the control and protection of the data [11]. Therefore, the use of Cloud computing technology puts the user in constant concern about the trust worthiness of security and protection measures set by the service providers to prevent unauthorized access [12]. Moreover, the issue of availability of application and resources if there is any issue of the connection can decrease the level of confidence that users have towards Cloud computing adoption. The lack of confidence in the protection of resources can negatively impact the competitive capacity of the business organizations in comparison with the other business [13]. Addition, Confidence Level (CL) of users can be affected by user trust. Trust is viewed as user belief that developed from user experience to take decisions. Trust has characteristics like dependability, reliability, honest, confidence, and belief [14].

Perceived Ease of Use (PEOU) is another factor that influence technology adoption. Perceived Ease of Use (PEOU) is defined as belief that a person believes that the use of a particular technology will be easy [15]. Many previous scholars have confirmed that there is a relationship between Perceived Ease of Use (PEOU) and new technology adoption [16]. Cloud computing technology considers as ease of use technology, in other words user friendly due to the features that it provides such as: accessing through any type of devices and sharing information anytime without boundaries [17].

Perceived Usefulness (PU) as a factor that influences technology adoption is explained. Usefulness is defined as capable of being used advantageously. Perceived Usefulness (PU) is defined as belief degree that a person believes that the use of a particular technology will be valuable and improve performance [15]. Therefore, Technology Acceptance Model (TAM) is the theoretical underpinning of the conceptual model.

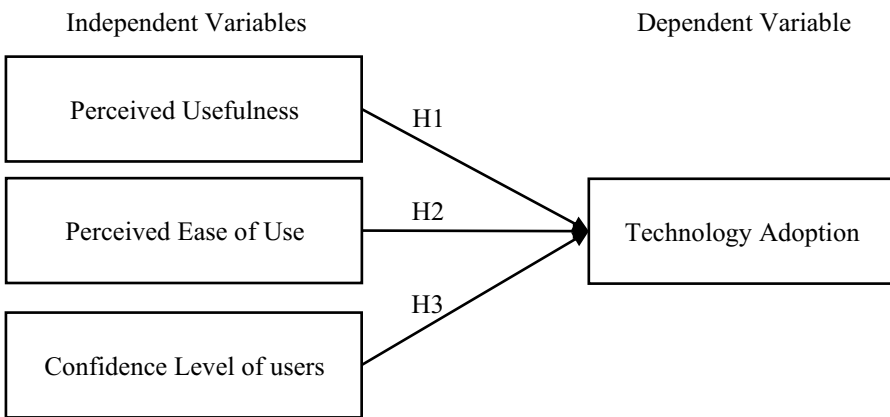


Fig. 1. Conceptual Framework

The following hypothesis was developed.

1. Hypothesis 1 (H1): Perceived Ease of Use (PEOU) significantly affect Cloud computing technology adoption.
2. Hypothesis 2 (H2): Perceived Usefulness (PU) significantly affect Cloud computing technology adoption.
3. Hypothesis 3 (H3): Confidence Level (CL) of users significantly affect Cloud computing technology adoption.

3 Methodology

Only three companies of oil and gas industries chosen: Bahrain Petroleum Company (BAPCO), Tatweer Petroleum, and Bahrain National Gas Company (BANAGAS). Target population are Information Technology (IT) engineers, managers, technicians, specialists, and experts. Target population is of 110 employees in the selected three companies as shown in table 1.

Table 1. Target Population

No.	Company Name	Estimated Number of Employees in Information Technology (IT)
1	Tatweer Petroleum	63
2	Bahrain Petroleum Company (BAPCO)	31
3	Bahrain National Gas Company (BANAGAS)	16
Total Target Population Size		110

Source: (IT managers, Personal Communication, September 1, 2020)

Table 1 employee numbers were collected through informally asking Information Technology (IT) managers of each company when the questionnaire web link was shared. A non-probability sampling technique is used such as convenience sampling. [18]. A questionnaire survey was conducted through emails by using "SurveyMonkey". The e-mails ID of respondents were obtained from Information Technology (IT) managers of the respective companies. A pilot test was conducted and was distributed to five respondents. All the measures were modified and adapted from published literature.

4 Data Analysis and Results

A summary of the respondent’s profile is shown in Table 2 below:

Table 2. Profile of Respondents

Demographics Profile		Frequencies	Percentage
Gender	Male	74	83.1
	Female	15	16.9
Age Mean (μ) = 32.7 years Standard Deviation (σ) = 9.91	21 –30 years old	26	29.2
	31 –40 years old	33	37.1
	41 –50 years old	19	21.3
Level of Education	Above 50 years	11	12.4
	Diploma	6	6.7
	Bachelors	61	68.5
	Masters	20	22.5
	Doctorate/PHD	0	0
Educational Background	Others	2	2.2
	IT & related	56	62.9
	Business & Related	2	2.2
	Engineering & Related	30	33.7
Current Job Position	Others	1	1.1
	Technician	8	9.0
	IT Specialist	49	55.1
	Engineer	18	20.2
	Supervisor	5	5.6
Consultation in IT decision in past 3 years	Management	9	10.1
	Yes	72	80.9
	No	17	19.1
Knowledge and Skills on Cloud	None	11	12.4
	Beginner user	37	41.6
	Moderate user	35	39.3
	Advanced user	6	6.7

N=89

4.1 Multiple Regression Analysis

A multiple regression analysis is done to investigate the relationships between Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Confidence Level (CL) of users and Cloud computing technology adaption. According to Table 3, agility factor with the highest predictive beta ($\beta=0.321$) on Cloud computing technology adaption, is positively significant with adoption of Cloud computing technology adaption ($p<0.01$). Hence, Hypothesis H2a is supported. Trust factor with predictive beta ($\beta=0.291$) on Cloud computing technology adaption, is positively significant with Cloud computing technology adaption ($p<0.01$). Hence, Hypothesis H3a is supported. On the contrary, Perceived Ease of Use (PEOU), scalability, availability, and security factors have no

significant relationship with Cloud computing technology adaption. Hence, H1, H2b, H3b, and H3c are rejected as shown in Table 3.

Table 3. Results of Multiple Regression Analysis

Variables	Beta (Step 1)	t	Sig.	Beta (Step 2)	t	Sig.
Control Variables						
Gender	-0.241	-2.247	0.027*	-0.067	-0.889	0.377
Age	0.138	1.105	0.272	0.056	0.619	0.538
Education Level	-0.242	-2.187	0.032*	-0.103	-1.334	0.186
Education Background	-0.023	-0.222	0.825	-0.002	-0.023	0.982
Job Position	0.049	0.389	0.698	0.045	0.485	0.629
Independent Variables						
Perceived Ease of Use (PEOU)				0.039	0.418	0.677
Perceived Usefulness (PU)						
Agility				0.321	3.367	0.001**
Scalability				0.049	0.459	0.648
Confidence Level (CL) of Users						
Trust				0.291	2.718	0.008**
Availability				0.188	1.861	0.067
Security				0.091	1.085	0.281
R2			0.125			0.628
Adjusted R2			0.072			0.574
R2 change			0.125			0.628
F value			2.367			11.796
F value change			0.046			0.000

Note: n=89, *p<0.05, **p<0.01, Beta=standardized beta coefficient

Table 3 shows that adjusted R2 indicates that 57.4 percentage variance of the dependent variable is explained by the independent variables. The significant value of 0.001 indicates that agility is significant with adoption of Cloud computing technology adaption and 0.008 indicates that trust is significant with adoption of Cloud computing technology adaption.

5 Discussion and Implication

The result indicates that only Agility and Trust are found to be the most influential factor affecting Cloud computing technology adoption. Hence, hypothesis H2a: *Agility significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain* was supported. This in turn had partially supported the hypothesis H2: *Perceived Usefulness (PU) significantly affect Cloud computing technology adoption in oil and gas industry in Bahrain*. In addition, hypothesis H3a: *Trust significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain* was supported. This in turn had partially supported the hypothesis H3: *Confidence Level (CL) of users significantly affect Cloud computing technology adoption in oil and gas industry in Bahrain*.

Secondly, the findings of this study show that Perceived Usefulness (PU) is significant with Cloud computing technology adoption. Users are more willing to choose a technology when they believe that the technology offers a better option and provides more benefits [19]. This finding is consistent with the study done by Daud & Abdul Rahman [6], whereby technology adoption is considered useful if the technology provides certain features [17], Tripathi [21]; Bachleda & Ouaziz [5]; Ratten [18]. Hence, the findings of this study show that hypothesis H2: *Perceived Usefulness (PU) significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain*.

Thirdly, the findings of this study show that one factor of Perceived Usefulness (PU), Agility is significant with Cloud computing technology adoption. This indicates that the technology adoption is affected by the technology being agile which is able to implement rapidly to reflect the changes in a business requirement [9]. This finding is consistent with the studies done by Wang [23] and Xue & Xin [25] whereby users are more willing to choose a technology when they believe that the technology is a better option by providing more benefits. Hence, the findings of this study show that hypothesis H2a: *Agility significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain*.

Fifthly, the findings of this study show that Confidence Level (CL) of users is significant with Cloud computing technology adoption. This finding is consistent with the study done by Jelonek & Wysocka [13]; Alkhater, Wills, & Walters [3]. Hence, the findings of this study show that hypothesis H3: *Confidence Level (CL) of users significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain*.

Sixthly, the finding of this study shows that one factor of Confidence Level (CL) of users, Trust is significant with Cloud computing technology adoption. This indicates that the Cloud computing technology adoption is affected by the belief that respondents have had experience in utilization of similar technologies. Majority of respondents in this study are from a technical background (96.6 percent) which indicates that they are familiar with technologies. This finding is consistent with the study done by Bachleda & Ouaziz [5]. The Trust element in Confidence Level (CL) of users indicates that trust is an important factor that leads to technology adoption based on studies done by Farooqi [8] and Hosein [11]. Hence, the findings of this study show that hypothesis H3a: *Trust significantly affects Cloud computing technology adoption in oil and gas industry in Bahrain*.

Ninthly, the findings in this study show that the control variables, gender and education level are significant with Cloud computing technology adoption. These findings are consistent with the studies done by Mou, Shin, & Cohen [15] and Yang & Lee [26]. In terms of education level, the majority of the respondents are well educated (68.5 percent of respondents have a bachelor's degree and 22.5 percent of the respondents have a master's degree). This indicates that the more educated the respondent the more likely to have the intention or to be more receptive to adopt new technologies like Cloud computing technology. In terms of gender, gender shows to have significant effect on technology adoption. In this study out of 89 respondents, 83.1 percent of respondents are males forming a majority of respondents. Therefore, gender being significant could be attributable to males being pre-dominant in the field of Information Technology (IT) and engineering. This could indicate a 'digital divide' between males and females.

5.1 Managerial Implications

Findings of this study should help the oil and gas companies to understand business value added when managers decide to adopt Cloud computing technology. This is in adherence to "Cloud First" policy by government ministries and agencies intention. Agility as a factor of Perceived Usefulness (PU) affects Cloud computing technology adoption where Cloud increases the agility of the system. The importance of Agility could be seen more clearly when using Cloud result in building Information Technology (IT) environment in organization as this new requirement will take only few days or less. Since adding new requirements in on-site premises or purchasing an equipment procured is through the Bahrain Tender Board (BTB) which can take a couple of months. Cloud computing technology features of agility will reduce the time of achieving this requirement instead of a couple of months to a couple of days. This has cost implications to organizations. Furthermore, one of the frequent challenges in oil and gas industry is frequent fluctuations of the exports prices that is driven by demand and geopolitical changes. Hence, oil and gas companies can take the advantages of Cloud computing technology Agility by increasing and reducing the resources based on prices and demands. In addition, Trust as factor of Confidence Level (CL) of users that affects Cloud computing technology adoption where trust increases the user willingness to use and adopt this technology. Therefore, effective customer support available for 24 hours and experience of other companies in other industries in using this technology contribute to the trust by users. Introducing new technology gradually will improve Confidence Level (CL) of users as users get to be more familiar with the technology. For instance, starting with the non-critical system in order to increase user Confidence Level (CL). Furthermore, managers should focus on increasing the training of new technologies which will support in increase the Confidence Level (CL) of users. The insights provided by this study also suggest agility as a main feature to Cloud service providers to attract oil and gas industrial companies to adopt Cloud computing technology. The finding of this study recommend that Cloud computing service providers companies should direct their efforts toward improving the features of Cloud computing technology in order to encourage the widespread use of such a technology. This will contribute to build the user Confidence Level (CL).

Moreover, Cloud computing technology will add value in the adoption of Industry 4.0 and digital transformation initiatives including Artificial Intelligence (AI), Machine Learning (ML), Virtual Reality (VR), and Augmented Reality (AR). This is due to scalability of Cloud computing technology and built-in technology that can be used immediately.

6 Limitations of the Study

Firstly, small sample size of respondents. Secondly, this study focuses on Information Technology (IT) employees. No other industries in Bahrain were investigated. No interactive effects were examined. A cross sectional study. With a focus on Perceived Ease of Use (PEOU), Perceived Usefulness (PU), and Confidence Level (CL) of users. No other factors were examined.

7 Recommendations for Future Research

Larger Sample Sizes. Other Factors such as cost benefits, accessibility, and top management support in relation to adoption of new technologies. Longitudinal. Factors such as Confidence Level (CL) of users could change over time so a longitudinal study could be suitable.

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