

ADOPTION OF CLOUD COMPUTING IN PALESTINIAN MINISTRY OF TELECOMMUNICATION AND INFORMATION TECHNOLOGY: A FRAMEWORK DEVELOPMENT

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ABSTRACT

In the information technology sector, cloud computing has clearly become very strong driving force by taking over 90% of global enterprises using cloud as major part of their business. This study aims to introduce a comprehensive framework for the adoption of Cloud Computing and to determine the influencing factors in Palestinian Ministry of Telecommunication and Information Technology from point of view of employees from the ministry. Depending on two prominent frameworks: Technology-Organization-Environment framework and Diffusion of innovation framework. The researcher used the quantitative methodology to answer the research question and test the hypotheses. The questionnaire was delivered to the employees and received from 69 respondents from 75 disrupted survey. In order to evaluate the internal, convergent, and discriminant validity of the instrument, validity and reliability tests of panel data were performed. The linear regression analysis was deployed to test the research hypotheses and come out with findings, recommendations, and future to consider it when developing a framework to adopt. Statistical analysis shows that there are some factors rejected and others were accepted. The supported factors were: Competitive Pressure, External Support, Security, Top Management Support and Organization Readiness, and the others are not significant.

Keywords: Cloud Computing, E-Government, Technology-Organization-Environment, Diffusion of Innovation, Framework.

INTRODUCTION

In some way or another, cloud computing imitate the historic traditional mainframes in its concept, where a main server acts at the parent for many terminals. One of the most important definitions of Cloud computing is that "it is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., Networks, servers, storage, applications, and services); it can be rapidly provisioned and released with minimal management effort or service provider interaction" (Iinedo, 2011).

Moreover, Cloud Computing can be defined as "a standardized IT capability (services, software, or infrastructure) delivered via Internet technologies in a pay-per-use, self-service way." (Eurofin hospitality report, 2013). This definition focuses more on the service model

and business model of the cloud; but it ignores the deployment models (public, private, hybrid, community). Nowadays most of companies struggle with the technology requirements, including the physical position of servers and software issues.

It is expected that the cost of implementation, maintenance of this technology will be paid off over time through attaining better and improved performance.

Most companies who use to run traditional technology are still using the same old technology. The shift to cloud technology requires a well-defined strategy from A to Z, to successfully implement it according to the size of the organization: small, medium, or Enterprise (Sean & Kevin, 2012).

Moreover, IT infrastructure services basically depending on internet such as Web Applications become primary

pillar for most organizations. These organizations trending to cloud computing where these services can be found already in existence, easy to use, highly available, and reliable, also meets dynamic business needs. This technology will serve the business management with high efficiency (Ifinedo, 2011).

Cloud Computing could be useful for the developing countries as they do not have enough funds to have their own Information Technology infrastructure and services. This is very true in the case of Palestine which has a special situation. In addition to being one of the developing countries; it is also an occupied country.

This research aims at supporting the Palestinian public sector (Specially the Ministry of Telecommunication and Information Technology) by creating a cloud-computing framework that will serve as a platform for innovation and evolution of the overall infrastructure.

1. Previous Works

In the last ten years, the ICT sector in Palestine has encountered continuous growth in products and services provided to businesses, government, and households. Moreover, the ICT contribution to Palestine's GDP with an estimate of 8%, while employing 3% of the entire work force. The role of the internet and social media becomes more and more prominent during the last few years that opens new investment opportunities in the sector (Eurofin hospitality report, 2013).

Cloud computing has been a buzz word in the computing

field for many years now, the term has been widely used with many businesses not fully understanding what it is and how it will benefit them because it was still underlying virtualization technology (Sean & Kevin, 2012). Table 1 shows the pros and cons of cloud computing obtained from the literature. Table 1 shows that Cloud Computing has positive implications and will cause some negative aspects on the organization adopting it, specially, bandwidth sharing that could cause delays or slowing down the time needed for processing or retrieving information (Voorsluys, Broberg, & Buyya, 2011).

Sometimes the organization decide to move to new technology to reserve its location in the market and get the competitive advantage to overcome other companies. When planning to migrate to the cloud, the IT managers should evaluate the physical infrastructure that must be robust and reliable to reach the desired benefit, and this is an issue that may jeopardize the deployment of the cloud (Nanos, Manthou, & Androutsou, 2019).

Technology-Organization-Environment (TOE) is a framework that studies the factors that affect the adoption process of cloud computing. The context for change: Organization, technology, and environment (Depietro, Wiarda, & Fleischer, 1990). The three main factors of the TOE framework are the technological context, the organizational context, and the environmental context. The technological context contains all the relevant technologies to the company,

Pros	Cons
Enables economies of scale, lead to cost savings which can be used through the significant pooling of these "configurable computing resources" (Hayes, 2008)	Security and Privacy; it affects the cloud computing model because there is an outside use of third-party services and infrastructure that are used to host important data (Takabi, Joshi, & Ahn, 2010)
Allows organizations to focus on their core business (Hayes, 2008)	Availability and Fault-Tolerance: level of service provided, the availability of this service, system performance and the measurements when there is something error occurred in the system that must be taken (Jansen and Grance, 2011)
Ease of Implementation, the organization can apply cloud computing quickly; no need to purchase hardware, software licenses (Craig et al., 2009)	Resource Management and Energy-Efficiency, the use of virtualized resource pools, CPU usage, disk space, and network bandwidth must be sliced and shared among virtual machines running potentially heterogeneous workloads (Voorsluys et al., 2011)
Flexibility (Elasticity), Scalability, Access to high-caliber devices and software Capabilities of IT, Reduce the expenses of time and money (Craig et al., 2009)	Vendor lock-in and lack of standards, providers could not meet the client's requirements, and cloud computing infrastructures and their platforms do not use standard methods of storing user data and applications (Takabi, Joshi, & Ahn, 2010)

Table 1. A Comparison between Pros and Cons of Cloud Computing

and we will study two main factors Security and Cost. Organizational Context, this factor is related to the management hierarchy and size, also resources and characteristics of the company and these factors are Top Management Support, Regulatory Support, and Organization Readiness. The arena which the organization conducts with its business, service provider, internal or external competitors, and the factors from the surround of the firm, is Environmental Context, which include factors: Competitive Advantage and External Support. Many research studies have shown that the TOE model has been implemented in broad applications and has power across many industrial, national/cultural, and technological contexts. Also, TOE has been used in the new technology adoption decision inside the firm systems (Grover, 1993; Mishra, Konana, & Barua, 2005; Rogers, 2010).

In contrast, Theories such as Diffusion of Innovation (DOI) is looking at how new technologies are diffused and adopted by the firm, and DOI framework applied to many studies in the field (Seyal, Awais, Shamai, & Abbas, 2004). DOI is a model for adoption (Rogers, 1995), which explains the theory of why, how, and at what rate the new technology and ideas will spread out through the firm culture and individual, and its factors are: Relative Advantage, Compatibility, Knowledge, Complexity, Trialability, and Innovation Level.

2. Methodology

Since the purpose of this study is to identify the determinants that will affect the adoption of the Cloud Computing in ICT sector, which will be applied in the Ministry of Telecommunications and Information Technology (MTIT) in Palestine. The descriptive analytical approach is used in this research. The researcher tried to test the factors that influence the MTIT to develop that framework for adoption of the cloud computing.

The researcher employs a quantitative approach for conducting cloud computing framework adoption. Quantitative data such as end user's feedback on the IT applications contribute to the technical impact on efficiency and productivity. Qualitative data such as

business domain, business services, and IT application cost drivers are used to determine the business value of the IT applications in an organization.

The researcher will use primary resources divided into parts: The First part is employing a questionnaire to conduct an empirical investigation through testing the factors of the TOE framework, which this framework considered to be standard to adopt new technology, and involve the ICT managers and who is relevant, hence they face the coming danger and be aware of cloud computing technology. Afterwards, the questionnaire aims at defining the barriers that prevent them to transform to cloud computing and implement the optimal framework.

The second part of primary resources is practice review to the proposed questionnaire with the ICT managers, to come back with the final feedback on the first part to utilize it in their formations and enrich the survey with their expertise, which is applied to the case study and geographical location.

The population of the research consists of Ministry of Telecommunication and Information Technology employees of IT and management. The population was 85 employees to whom the survey was given to all of them.

In order to analyse the quantitative data of the research, the questionnaire is used as a main research tool for collecting primary data. The factors of the questionnaire will be derived from the standard TOE framework determinants, and will be measured through that survey and become with the results. Then analyse the results through SPSS statistical software.

The research hypotheses that is created for each construct to speculate upon the outcome of the experiment. Then hypothesis for each construct is presented in the questionnaire design and they are:

- H_1 : There is a statistical significant positive relation between relative advantage and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_2 : There is a statistical significant positive relation between compatibility and the adoption of Cloud

Computing (at level of significance $\alpha = 0.05$).

- H_3 : There is a statistical significant positive relation between security and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_4 : There is a statistical significant positive relation between cost and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_5 : There is a statistical significant positive relation between Regulatory Support and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_6 : There is a statistical significant positive relation between top management support and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_7 : There is a statistical significant positive relation between competitive pressure and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_8 : There is a statistical significant negative relation between Complexity and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_9 : There is a statistical significant negative relation between Trialability and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_{10} : There is a statistical significant negative relation between Organizational Readiness and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_{11} : There is a statistical significant positive relation between External ICT Support and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_{12} : There is a statistical significant positive relation between Cloud knowledge and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).
- H_{13} : There is a statistical significant positive relation between Level of Innovativeness and the adoption of Cloud Computing (at level of significance $\alpha = 0.05$).

The expected output would help the ICT sector that is related to this case study, in order to create a modified framework that help the ICT managers to follow, leading to better and optimal performance.

The prepared questionnaire proposed to capture respondents' point of view about cloud computing adoption and its determinants that may influence the adoption process in the facility. The items were designed based on five point Likert-type scale. It is considered as one of the most common formats used in questionnaires. In this research, the majority of the items that are used in the survey were adapted from previously published journal articles, which have been validated in different perspective.

So according to the research objectives, the survey was prepared, which consist of two main groups: group A and B. The first group (A) contains demographic information related to the respondent and the second group (B) is structured to 9 different classifications. Table 2 shows the group B Questions.

The researcher designed the group B of the questionnaire in 14 main categories, and they are: relative advantage, compatibility, competitive pressure, regulatory support, security concerns, cost savings, Regulatory Support, cloud computing adoption, complexity, trialability, cloud knowledge, external ICT support, and top manager support.

3. Questionnaire Items Validation

In order to ensure the content validity and more understandable for respondents of the questionnaire items, the questions were reviewed by a panel of experts to check the clarity and evaluate the validity of the content. It was first reviewed by 2 PhD professors from engineering management department at An-Najah National University, a Software Engineer, Services Director, System Engineer, and Senior datacenter administrator. Based on their experience and knowledge, some of the items were deleted, some modified, some were added to the questionnaire, and the rest of the items were stayed as they are.

A pilot study was conducted to check the reliability of my questionnaire. The pilot study was conducted on 10 employees, the findings of the pilot study were measuring mainly the Cronbach's Alpha and it was equal to 90.9%, which indicates a high level of internal consistency for our

Classification	Questions
Relative advantage	<p>Cloud Computing allows you to manage business operations in an efficient way.</p> <p>The use of Cloud Computing services improve the quality of operation</p> <p>Using Cloud Computing allows you to perform specific tasks more quickly.</p> <p>Using Cloud Computing allows you to increase business productivity.</p> <p>Cloud computing allows us to use the latest version of the technology</p> <p>Cloud computing would enhance our company's data storage capacity</p>
Compatibility	<p>The use of Cloud Computing fits the work style of the company.</p> <p>The use of Cloud Computing is fully compatible with current business operations.</p> <p>Using Cloud Computing is compatible with your company's corporate culture and value system.</p> <p>The use of Cloud Computing will be compatible with existing hardware and software in the ministry.</p> <p>Cloud can easily be integrated into our existing IT infrastructure</p>
Security	<p>Degree of ministry's concern with data security and privacy on the Cloud Computing</p> <p>Degree of concern for customers with data security in Cloud Computing</p> <p>Adoption and use of cloud computing technology affects the development of a plan to protect the security and confidentiality of information Cloud providers' servers and data centers are secure</p>
Cost	<p>The benefits of Cloud Computing are greater than the costs of this adoption.</p> <p>With Cloud Computing there is a reduction of energy costs and environmental costs.</p> <p>Maintenance costs of Cloud Computing are very low</p>
Cloud knowledge	<p>I have the knowledge about cloud computing</p> <p>I have the knowledge about the benefits of using cloud computing</p> <p>I know about different types of cloud (public, private, and hybrid cloud)</p> <p>I have the knowledge about the underlying structure of cloud computing</p>
Top Management Support	<p>The company's management supports the implementation of Cloud Computing.</p> <p>The company's top management provides strong leadership and engages in the process when it comes to information systems company.</p> <p>The company management takes risks (financial and organizational) involved in the adoption of Cloud Computing.</p>
Competitive Pressure	<p>The Ministry think that Cloud Computing has an influence on competition in their industry.</p> <p>Our ministry is under pressure from competitors to adopt Cloud Computing.</p> <p>Some of our competitors have already started using Cloud Computing</p>
Regulatory Support	<p>There is legal protection in the use of Cloud Computing</p> <p>The laws and regulations that exist nowadays are enough to protect the use of Cloud Computing.</p>
Cloud Computing Adoption	<p>The organization is currently engaged with Cloud Computing adoption</p> <p>I recommend the organization to evaluate Cloud Computing adoption, but do not plan to adopt this technology</p> <p>I recommend the organization to adopt services, infrastructure, or platforms of Cloud Computing.</p> <p>The ministry has a management plan its goal to adopt cloud computing</p>
Complexity	<p>Working with cloud computing is complicated</p> <p>It takes too long to learn how to use the cloud computing</p> <p>In general cloud computing is very complex to use</p> <p>There is an adequate budget to adopt Cloud Computing in the ministry.</p>
Trialability	<p>I have a great deal of opportunity to try various types of cloud computing</p> <p>Cloud computing is available to me to adequately test run various applications</p> <p>Before deciding whether to use any cloud computing service I would able to properly try them out and its services easily</p>
Organizational Readiness	<p>The ministry knows how IT can be used to support operations.</p> <p>There are within the company the necessary skills to implement Cloud Computing.</p>
Level of Innovativeness	<p>I am a kind of person who usually comes up with new ideas</p> <p>I would rather create something new than improve something existing</p> <p>I often take risk doing things differently External ICT Support</p> <p>For our ministry, receiving an excellent technical support from cloud provider</p> <p>For our ministry receiving an exceptional customer service</p> <p>for our ministry, It is important to offer customer hot-lines by cloud providers</p> <p>It is important for our ministry to receive training from cloud providers</p>

Table 2. The Group B Questions of the Questionnaire of the Study

scale, in that case will remain 75 to distribute. The researcher distributes 18 electronic questionnaires and

the rest hardcopy. The collected questionnaire from both electronic and hardcopy equals to 69, so the response rate was 92%.

4. Results and Discussion

To illustrate the statistical differences among participants in this research, the researcher used Linear Regression, and One-Way ANOVA Test; these two tests are used in order to see whether that the distribution set of values observed for each category of a variables differs from a specified distribution.

Linear regression is the relationship between a scalar dependent variable and one or more explanatory

variables (or independent variables) (Yan & Su, 2009). Table 3 shows the results of ANOVA test for all factors of the framework and the descriptive statistics. It should be noticed after applying the Bonferroni criteria for the significance and the new alpha would be $0.05 / 13 = 0.00385$. Any p-value for the ANOVA test below this value is significant. Otherwise it is not significant.

The results of Table 3 show that none of the demographic variables was significant at the Bonferroni alpha level of 0.00385. Hence these demographic variables have no significant impact on the level of adoption of Cloud Computing at MTIT with alpha level found.

Factor	ANOVA Test					
	Specialty p-value	Gender p-value	Qualification p-value	Age p-value	Exp. Years p-value	Position p-value
Relative Advantage	.250	.687	.058	.193	.243	.694
Compatibility	.019	.297	.680	.668	.699	.036
Security	.056	.760	.674	.480	.185	.007
Cost	.021	.327	.888	.588	.923	.671
Knowledge	.209	.318	.440	.174	.570	.102
Top Management Support	.036	.598	.398	.931	.290	.037
Competitive Advantage	.017	.543	.866	.579	.299	.585
Regulatory Support	.583	.222	.032	.727	.143	.336
Adoption	.139	.722	.221	.273	.668	.217
Complexity	.076	.782	.734	.339	.800	.285
Trialability	.118	.249	.518	.128	.153	.235
Organization Readiness	.277	.839	.898	.947	.843	.078
Innovation Level	.895	.596	.387	.706	.797	.234
External Support	.042	.898	.994	.764	.144	.377

Table 3. The ANOVA Test for all Factors of the Study vs. Demographic Variables

Hypothesis	(ρ) Pearson Correlation	T-Value	P-Value (Significant)	Supported
H ₁ : Relative Advantage affect Adoption of Cloud Computing	.301	0.945	.348	Not Support
H ₂ : Compatibility affect Adoption of Cloud Computing	.502	2.098	.040	Not Support
H ₃ : Security Concerns affect Adoption of Cloud Computing	.504	4.252	.000*	Support
H ₄ : Cost affect Adoption of Cloud Computing	.212	0.621	.537	Not Support
H ₅ : Regulatory Support affect Adoption of Cloud Computing	.627	3.596	.001*	Support
H ₆ : Top Management Support Affect Adoption of Cloud Computing	.648	3.900	.001*	Support
H ₇ : Competitive Pressure affect Adoption of Cloud Computing	.622	3.594	.001*	Support
H ₈ : Complexity negatively affect Adoption of Cloud Computing	.612	2.144	.019	Not Support
H ₉ : Trialability affect Adoption of Cloud Computing	.421	2.143	.036	Not Support
H ₁₀ : Organizational Readiness Affect Adoption of Cloud Computing	.429	0.069	.946	Not Support
H ₁₁ : External ICT Support affect Adoption of Cloud Computing	.632	3.822	.000*	Support
H ₁₂ : Cloud Knowledge affect Adoption of Cloud Computing	.003	-0.081	.491	Not Support
H ₁₃ : Level of innovativeness affect Adoption of Cloud Computing	.351	1.816	.074	Not Support

Table 4. Results of all Factors and its Relationship with Adoption and its Significance

Some of these factors in Table 4 are supported and significant at alpha level of 0.00385 (Competitive Pressure, External Support, Security, Top Management Support, and Organization Readiness) and the others are not significant. In addition, these factors are derived from TOE and DOI frameworks, and from previous empirical studies, results supporting some factors of TOE framework and some factors from DOI framework (Craig et al., 2009; Nanos et al., 2019).

The implications of the results found in Table 4 is that when considering the adoption of cloud computing, the following considerations should be taken into account in the organization, namely Issues covered by supported hypotheses (H_3 , H_5 , H_6 , H_7 , and H_{11}). Security is the first issue that should be taken into account. Cloud computing needs expertise and knowledge to ensure it is safe and secure specially for a ministry. Data is important to maintain and protect and can be accessed by authorized personnel. The second supported hypothesis is Regulatory issues. Cloud computing cannot be implemented without the support of regulations and laws to protect, encourage its use, and limit violations. Other ministries might not consider adoption of cloud computing unless they are forced. The next issue is top management support, as any change that is happening in any organization the support from top management is a critical success factor. Cloud computing is one big change and might affect a lot of departments, so support from top management is a must in the implementation. The model also found that competitive pressure affects the adoption of cloud computing. Pressure from other ministries, neighboring countries, or international organizations have the impact to speed up the adoption of such technology. Finally, the research found that the existence of good external ICT support encourages the adoption of cloud computing. The support from other entities enable the change, removes barriers, and eases the adoption of cloud computing.

Conclusion and Recommendations

The research analysis had used the exploratory and descriptive analysis; the research consists of two parts: the first part is an exploratory research used through Literature

review, which reviewed previous article and studies, international journal papers, books, and internet. The second part is a descriptive analytical approach by using quantitative survey, which was distributed with sample size ($n=85$) of employees at MTIT in Palestine which tries to achieve research's objectives by testing the determinant factors and to test hypotheses. The researcher retrieved 69 responses with a response rate of 92%. Furthermore, Palestinian ministry of telecommunication and IT encourages and tries to adopt some projects that support the adoption process; Cloud computing helps in replacing enterprise hardware and software with their traditional technology. The Palestinian ministry of telecommunication and IT is ready to adopt cloud computing in its operations after ensuring the following adoption areas: Security, Regulatory, top management, competitive pressure, and External support.

The research applied on one institution separated from other ministries which may affect some factors to be considered, so that the findings of the research will not reflect the general case of the adoption process in the Palestinian organizations either the private or the public. Also, this research results cannot be generalized, due to the questionnaire distributed only in Palestinian MTIT, in addition so it is only applicable to small size sample of the study, on the other hand, other studies used large sample size and in large ICT sectors. Finally, the knowledge about cloud computing in Palestine in general still at its first stages and new phenomenon, so the collection of data will be hard, and this will reduce the number of studies that will be conducted to this new field. The researcher recommends investigating other ministries and other private institutions that is thinking to apply cloud computing.

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