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Critical Factors Influencing Adoption of Cloud Computing for Government Organizations in Yemen*

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Abstract

Purpose - Many countries nowadays look at cloud computing as an opportunity because it holds great advantages for governments. Public sector in Yemen still uses traditional computing. This study tends to explore the factors that would affect cloud computing adoption in government organizations in Yemen.
Research design, data and methodology - We used a combination of DOI theory and TOE framework with some changes to suit the context of government organizations. Eight hypotheses were proposed with a questionnaire developed and sent to people in Yemen. 118 responses were collected to assess the hypotheses.
Results - Results indicate that Yemen lacks some prerequisites of cloud technology in terms of technological readiness and regulations. The factors: relative advantage, compatibility, security concern, perception of benefits and government support were accepted. Perception of benefits, in particular, is found to affect the decision of adoption. Security concern also showed a direct and indirect influence on cloud adoption in the government. Respondents consider security a key issues of the technology. The factors: complexity, technology readiness and regulatory support were rejected.
Conclusions – Based on all analysis results, this study proposed some steps toward adopting cloud computing in Yemen.

Keywords: Cloud Computing, Yemen, Government Cloud, Adoption, DOI and TOE.

JEL Classifications: R42, F53, F13.

1. Introduction

The advent of computing revolution in industrial societies shows signs of revolutionizing information society. We are at an inflection point - a true shift of paradigm - in the evolution of computing. The history of computing encompasses a series of such shifts, from the age of mainframes to the introduction of the personal computers (and now, to netbooks and mobile devices), from the client-server to the networked model, and from the age of isolation to the age of the Internet(Trivedi, 2013). Cloud computing is defined as a business model of delivering IT resources and applications as services accessible remotely over the internet rather than locally (Wojciech & Sergiusz, 2009).

While the level of certainty is limited with regard to the speed and the ultimate reach of cloud computing, one thing that appears to be sure is that “business as usual” will be soon very different due to the advent of cloud computing (Wyld, 2010). Cloud computing has been quite often depicted and recognized as a new technology, but also commonly accepted as evolution of technologies like client-server, web, and networking(Trivedi, 2013). Some even name it the mainframe 2.0 due to the same central computing architecture.

Cloud computing offers great potentials to change the way business is carried out in private or public sectors by introducing IT as services as utilities like electricity and water. Therefore, businesses just use IT services and focus more on their core business rather than spending time and efforts on doing IT related work like planning, procurement, installation, maintenance, upgrade, backup and recovery. Cloud computing also provide a high level of standardization

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and make IT services even more attractive.

Many experts nowadays consider cloud computing to be “the next big thing” or the next wave after the web. Today, we see implementations of cloud computing across the public sector all around the world. Indeed, in many cases, governments are leading the development of cloud computing across the wider economy(Wyld, 2010).

Adopting cloud computing in government organizations is a new trend. Many countries nowadays pay attention to cloud computing because it holds a number of advantages for governments in areas of tremendous cost reduction, increased storage, higher levels of automation and standardization, increased flexibility, and higher levels of employees' mobility(Espadanal & Oliveira, 2012).

However, the public sector in Yemen is still deals with traditional computing. Each government organization works in silos, it has its own IT center equipped with hardware, servers, software and a technical team to operate and maintain its on-premise IT center. Therefore the capital and operational investments spent on IT is very big compared to services quality and availability, and in most cases it results in an inefficient utilization of resources. Here are many issues that explain the current status of computing in government organizations in Yemen(Mubarkoot, 2015):

(1) Lack of IT expertise in government organizations negatively affects the availability and the quality of IT services delivered. Organizations also spend efforts in planning, operating and maintaining their IT solutions besides their core business.

(2) Inefficient utilization of IT resources is widespread. Government organizations procure hardware and software and utilize less 50% of their capacity in most cases, which wastes money and resources that can be avoided with the adoption of cloud.

(3) Since each organization has its own technology and platforms, it is hard to achieve interoperability with other organizations, and therefore integration of IT solutions becomes very complicated.

This paper aims to investigate the potentials of adopting cloud computing in public sector in Yemen by measuring the important factors that critically influence the adoption of cloud technology in the government. Then, this study proposes a high level strategy toward better adoption of cloud in government organizations.

2. Cloud Computing in Governments

Cloud computing has conquered the consciousness of businesses over the last few years and increasingly getting translated into actions. Nowadays one is obliged to go to the cloud. The development in cloud computing is also leading many inside and outside of government sector to ask, “If it works for business, why not for government?” (Wyld, 2010). Cloud computing offers many benefits to the public sector. Possible advantages include cost savings, increased storage, higher levels of automation, enhanced flexibility and increased staff mobility. This suggests that governments should explore proper use of cloud computing (Schatz, 2009).

At the side of spending, it is believed that the current economic conditions and its resulting financial burden on governments is playing a key role in accelerating the adoption of cloud computing in the public sector(Ferguson, 2009), which indicates that cloud computing provides undeniable financial pay-back, higher utilization, lower energy use, and better application availability (Badger et al., 2011). The benefits are so great that IT organizations will be able to endure the challenges that accompany the cloud computing technology.

Thus, in this new era of budget savings, the challenge is to achieve more with less. Technology is therefore viewed as a driving force for new ways to bring efficiency and rationalization not only to computing, but also to government work itself from the budgetary point of view, the predictions for the influence of cloud computing on government IT expenditure are definitely eye-opening.

In many cases, the push toward using cloud computing comes from ordinary employees themselves looking forward to improve and simplify their work style by accessing cloud services that they’re using for their personal pursuits. In most cases, the employees themselves drive the transition. In that “If you don’t provide tools to your people, they’re definitely going to go look for other tools that are already available from a cloud providers and do it on their own way. Whether it is storing images on Flickr, collaborating in a virtual world or even using Facebook, they will find it” (quoted in Beizer, 2009)

U.S. (CIO) Vivek Kundra poses a fundamental question for federal IT strategy: “Government needs to start asking the question, ‘Are we building an IT organization? Or do we want to move out of the system of owning hardware and get services to deliver solutions to customers faster?’” (quoted in Lynch, 2008). So investing in technology is good, but more importantly should be outcome-oriented.

But there are some challenges associated with the adoption of cloud in that (1) users must have near-ubiquitous access to the internet, (2) cloud systems must be equivalent to or better than current standalone systems, (3) barriers between government institutions should be opened and (4) security and privacy of users’ data must be clearly defined and protected (Rayport et al., 2009; Janssen & Joha, 2011). The level of challenge become more complicated when it comes to cloud adoption in developing countries like Yemen where prerequisites of cloud computing such as technology infrastructure and regulations are in very early stages. The lack of political leadership to push the adoption of such technology is another critical challenge.

Park (2014) - e-Government bureau, South Korea, was

interviewed about the strategy of "Gov3.0 Cloud" and he stated that the core values of Government 3.0 (openness, sharing, communication, and collaboration) requires eliminating and minimizing barriers between government organizations and transforming the way of work in the government. And as cloud computing serves as the basis for realizing Gov3.0, government of Korea needed to achieve automatic accumulation of knowledge on work and policies in the cloud, as well as share the knowledge to further improve problem-solving skills"(Park, 2014).

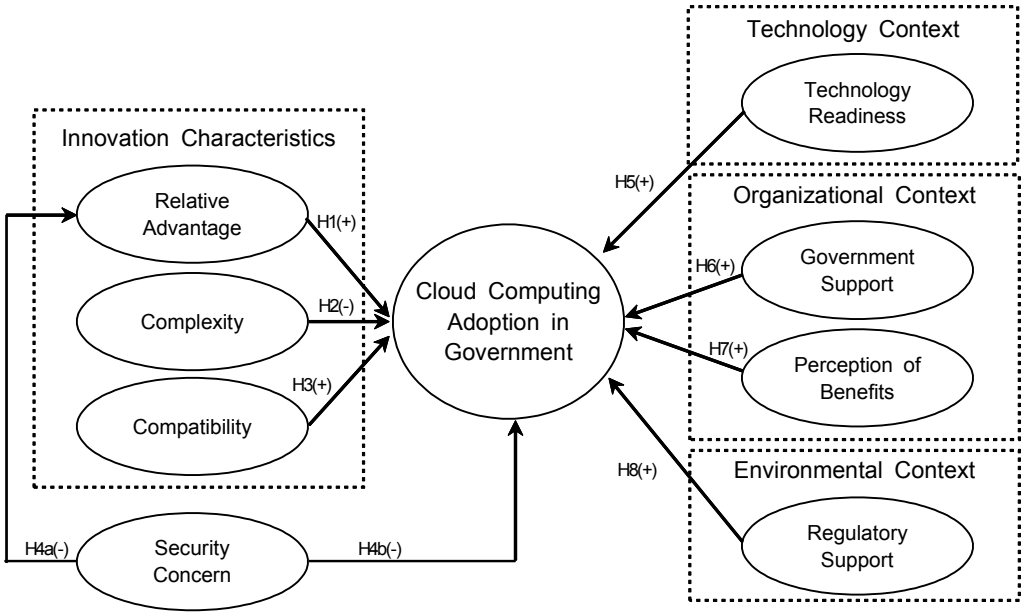
Many issues that remain to be worked out from a technology standpoint. Yet it is more likely that as with other major technological changes, the most important issues to be resolved will be people-based, not tech-based(Erlichman, 2009). Trigueros-Preciado et al. (2013) investigated some barriers to cloud adoption by surveying 94 SMEs and concluded that main barriers have more to do with culture types and the positive effects go far beyond cost reduction. Therefore the problems associated with the adoption of cloud are more related to people and culture than to technology.

3. Research model and hypotheses

Cloud computing is a disruptive technology that has not been matured with the lack of industry-specific conformity to standards(Nedev, 2014). Cloud computing may incur a high level of related risk and costs when being introduced in government organizations. Considering these characteristics, the study proposed 8 factors that affect different aspects of cloud computing adoption at a government organization level. The originality of the research model relies on two studies carried out by (Oliveira et al., 2014) which discussed the adoption of cloud computing in private sector. They combined both the theory of Diffusion of Innovation (DOI) and the Technology, Organization and Environment framework (TOE). DOI and TOE theories have been widely used for technology adoption at the firm level.

Some authors analyze technology adoption based on TOE framework and others choose to study it using DOI, but other researchers suggest studying technology adoption based on both models together to eliminate the possibility of ignoring some aspects that could probably have a great effect on the adoption strategy. Thus DOI and TOE are extensively used in IT adoption studies, and have enjoyed consistent empirical support(Low et al., 2011). Our research model therefore includes the characteristics of innovation stated in the DOI theory and the contexts defined in the TOE framework.

<Figure 1> shows the proposed research. The first box in the top left represents characteristics of DOI. Underneath characteristics of innovation is security concern. And the three boxes in the right represent the factors of TOE framework. The dependent factor is cloud computing adoption in government. Accordingly, eight hypotheses were developed to have either positive or negative influence on cloud adoption in government.



<Figure 1> Research Model

3.1. Innovation Characteristics

The diffusion of innovation (DOI) is a theory of how, why, and at what rate new ideas and technology spread through cultures(Wyld, 2009). DOI is mostly based on characteristics of technology and users' perceptions of the system. DOI theory views innovations to be communicated throughout certain set of channels over time and within a social system. In particular, Rogers (2003) analyzed the DOI theory and developed a set of characteristics that affect the adoption of innovation and those are: relative advantage, observability, complexity, compatibility, and trialability.

This part measures the factors of a new technology. However, this study slightly changed Rogers' DOI model to reflect government context. Both observability and trialability were excluded because they are not relevant to cloud-computing technology(Oliveira et al., 2014).

3.1.1. Relative advantage

This factor is a key driver that makes business move to the cloud. It can be stated as the extent of which a new an innovation is considered better than the current or previous ideas. It measures the degree to which an innovation can bring benefits to an organization(Rogers, 2003). In this context, cloud computing is viewed as a better technology for government organizations than the traditional way of computing(Nedev, 2014). While it is fairly small initial cost, cloud technology gives organizations the ability to respond to business needs very fast, which in turn allow them to deploy their solutions very quickly. It can also help businesses ensure that their employees have instant access to critical business information, using any device anywhere (Microsoft, 2010).

Relative advantage is also viewed from a perspective of time-savings. Faster implementation and deployment time is an advantage of cloud computing(Forbes & Tompkins, 2011). Another significant advantage of cloud computing is cost savings(Cervone, 2010). This allows customers to take advantage of a reduced capital expenditure because they use resources as a service on pay-per-use basis. By sharing computing resources between several users, utilization rate is tremendously improved, which means a big reduction in infrastructure costs(Rittinghouse & Ransome, 2010).

The advantages gained of adopting cloud technology can also be profound for IT departments in governments, and that starts with reducing or redirecting on-site technical staff and providing the capability to approach IT infrastructure and resources as needed.

<H1> Relative advantage will positively influence cloud adoption in government

3.1.2. Complexity

Complexity is the degree to which an innovation is perceived to be relatively difficult to understand and use (Rogers, 2003). In the context of government, people already got used to certain systems and routines. Therefore, when the government adopts the cloud, training and extra efforts are required to get the new technology into business, especially when there is a lack of expertise and IT specialists(Hong & Kim, 2002). Additionally, complexity could also come in a form of resistance from government leaders or government employees who see that cloud environment lacks certainty due to the fact that it resides out of the organization's premise or at least they would more likely have less control on their IT solutions.

<H2> Complexity will negatively influences cloud adoption in government.

3.1.3. Compatibility

Compatibility is the degree to which an innovation fits with the adopter's existing values, previous practices or current needs(Rogers, 2003). Compatibility of the cloud with existing infrastructure is considered as one of essential factors in the decision-making process to adopt the cloud. Therefore, the government should take into account compatibility of the cloud with the existing infrastructure in terms of vendor, solution and platform(Nedev, 2014). If the technology is not very compatible, there is a necessity to make changes in order to suit existing business. Otherwise, it would be a big challenge toward adopting the technology.

<H3> High compatibility will positively influence cloud adoption in government.

3.2. Security Concern

Security is a critical issue in cloud computing. Moving to the cloud adds new layers of complexity for securing data which in turn affects adoption decisions. With the convergence of storage and computing in a shared multi-user environment, cloud computing heightens the concerns of security(Schneiderman, 2011). Governments have a burden to protect citizen's data and ensure the availability of critical infrastructure such as water, power, health, communications, and banking. So security concern would negatively affect advantages gains out of adopting cloud computing.

<H4a> Security concern will negatively influence relative advantage.

Department of Economic and Scientific Policy conducted a survey under EU, which showed that 63% of government

CIOs considered security and privacy of cloud as a major issue for public cloud computing adoption(Tweneboah-Koduah et al., 2014). Cloud computing environment is associated with a very complex confidentiality and privacy concerns due to lack of regulations that protect users from disclosure of information to cloud service providers or any other cloud users.

<H4b> Security concern will negatively influence cloud adoption in government.

The process by which a firm adopts and implements technology innovations is also affected by technological context, organizational context, and environmental context (Low et al., 2011). DOI is also an important theory that leads us to various information systems innovations(Zhu et al., 2006), however, it leads specially with the context of innovation and tends to ignore other factors that can influence the government's decision to implement cloud computing such as environmental and organizational factors in which TOE framework takes into account.

3.3. Technology Context

Technology context refers to characteristics of technologies which are available for adoption by an organization, and the current status of technology in the organization(Tornatzky et al., 1990).

3.3.1. Technology Readiness

Technology Readiness includes infrastructure and IT human resources. It measures the readiness of an organization to adopt the new technology(Oliveira et al., 2014). This factor must be considered before organizations take a final decision. Nedev (2014) stated that the adoption of a new technology into any mature internal service of an enterprise can be very challenging and long breathing task because there exist many factors and obstacles to be considered. More importantly, it is noted that any new technology has the related resources in place before adoption decision is made.

<H5> Technology Readiness will positively influences cloud adoption in government.

3.4. Organizational Context

Organizational context contains the organizational structure, the presence of innovation- enabling processes like strategic behavior, informal communication of top management, and the size and slack resources of the organization(Tornatzky et. al., 1990). We excluded size of organization factor because cloud adoption in the government should take holistic approach in that government organizations' strategy toward cloud should be a part of a bigger strategy that the government pursues. We included government support and perception of benefits in order to well reflect the government context.

3.4.1. Government Support

Government plays an important role because cloud computing implementation may involve integration of resources and reengineering of processes(Low et al., 2011). In particular, top management support is a key factor in the adoption process and would ultimately affect adoption decision(Nedev, 2014). When top managers understand the importance of technology for their business, they positively influence other members in the organization and support the adoption decision. On the contrary, top managers could also resist and impede the adoption process if they do not perceive it well. That's the scope of business and the scope becomes more complicated when it comes to the government; and pushing this kind of initiative would undoubtedly require persistent and strong leadership and support from the government to guarantee the sustainability of the project. As a result, government support is very critical and has a considerably positive effect on the adoption of cloud computing(Barth, 2015).

<H6> Government support will positively influences cloud adoption in government.

3.4.2. Perception of Benefits

Perception of benefits refers to how decision makers and employees understand and perceive the value of cloud adoption in government organizations. It measures the level of perception of benefits of cloud computing from a perspective of government leaders and employees. If leaders and employees recognize the benefits of adopting a technology very well, they will push the adoption toward success; on the other hand if they resist, they will definitely impede the adoption process. Barth (2015) stated that perceiving benefits directly and indirectly have a positive and significant influence on cloud adoption in government. We hypothesize that if government leaders and employees understand and perceive those benefits, it would positively affect the success the adoption.

<H7> Perception of benefits will positively influences cloud adoption in government.

3.5. Environmental context

Environmental context mixes nearby market elements such as competitive pressure and regulatory support(Tornatzky et al., 1990). In Yemen most services delivered by government organization are monopolized which leaves no place for

competition on delivering services. Therefore competitive pressure has been excluded because in the government context of Yemen, it would have no effect on service provisioning.

3.5.1. Regulatory support:

This is set by the authority in order to convince the increase of IT innovations and promote adoption of cloud computing in government organizations. It is a critical environmental factor that can influence cloud computing adoption(Oliveira et al., 2014). In general, lack of regulations has a negative and significant effect on cloud computing adoption(Barth, 2015). The need for regulations on cloud technology is to protect customer's data and resolve any dispute that could happen between cloud vendors and customers. The same scenario goes also for government organizations. Thus existence of such regulations is a key enabler toward adopting cloud computing.

<H8> Regulatory support will positively influences cloud adoption in government.

3.6. Cloud adoption in government

This is the dependent factor of our study and it shows whether or not the respondents see cloud technology is worth adopting in government. A very few researches have undertaken a systematic study to empirically evaluate the impacts of innovation attributes and the contexts of technology, organization, and environment in government organizations. This study therefore used the research model <Figure 1> to determine the critical factors that have influence on cloud computing adoption in government organization.

4. Methodology and results

4.1. Measurement and data collection

This study carried out a survey in Yemen and data were collected through an online questionnaire. Measurement items were developed from literature except for “Perception of Benefits” and “Government Support”. Because most works in the literature deal with the adoption of cloud computing in private sector; we had to adjust the way of the questionnaire to fit the context of government organizations. Measurement constructs are described in Table 1. Measurement items for all factors were developed from the literature except for “Perception of Benefits”. Items for “Government Support” were the amendment of “Top Management Support” in the TOE framework. We used 7-point Likert scale, ‘1 = strongly disagree’, ‘4 = moderate’, and ‘7 = strongly agree’. An online survey was sent to people in Yemen. A total of 118 responses collected. The demographic distribution of the respondents is: (1) Level of Education(below university 1.7%, university 35.6%, post university 62.7%), (2) Field of Profession(academic 25.4%, administrative 22.0%, technical 52.5%), and (3) Knowledge of Cloud Computing(general 22.9%, very good 51.7%, expert 25.4%). This indicates that most respondents are in technical field and with a very good level of education. We faced a difficulty in surveying government employees in that it was hard to find people who have knowledge about cloud computing.

Structural equation modeling (SEM) is used to empirically assess the research model. SPSS and AMOS (version 18) were used to analyze the data and statistically evaluate the hypotheses.

4.2. Reliability Analysis

<Table 1> shows constructs of the model and reliability tests of each factor with composite reliability and average variance extracted. Results show that all factors have CR higher than 0.7 which indicate that all factors are reliable according to the analysis tools(Fornell & Larcker, 1981). Though the CR of complexity is the lowest but it’s within the acceptable range.

<Table 1> Constructs and Reliability

Constructs	Code	Original Items	Valid Items	Mean	CR	AVE
Relative Advantage	RA	5	3	3.879	0.938	0.834
Complexity	CX	4	2	5.038	0.712	0.557
Compatibility	CO	4	4	3.739	0.883	0.655
Technology Readiness	TR	4	2	3.237	0.853	0.745
Security Concern	SC	3	3	3.836	0.944	0.849
Government Support	GS	3	2	3.220	0.924	0.859
Perception of Benefits	PB	3	2	3.093	0.869	0.768
Regulatory Support	RS	3	3	2.655	0.911	0.774
Cloud Adoption in Government	CA	3	3	5.223	0.811	0.591

* Mean, Composite Reliability (CR) and Average Variance Extracted (AVE)

<Table 2> shows the discriminant validity which is the degree of how the measures of two constructs are empirically distinc (Hair et al., 2011). The diagonal numbers in bold are the square root of AVE and should be greater than the correlations between the construct(Fornell & Larcker, 1981). However, the table shows a multicollinearity between RA and the dependent factor CA in that the correlation value is 0.915 which is high, but it didn’t affect the reliability of the research model as a whole.

<Table 2> Discriminant Validity

	CA	RA	CX	CO	TR	SC	GS	PB	RS
CA	**0.769**								
RA	0.915	**0.913**							
CX	0.031	-0.241	**0.747**						
CO	0.517	0.570	-0.019	**0.809**					
TR	0.074	0.143	-0.357	0.261	**0.863**				
SC	0.439	0.384	-0.159	0.418	0.404	**0.921**			
GS	0.591	0.464	-0.088	0.654	0.426	0.525	**0.927**		
PB	0.362	0.217	0.258	0.564	0.226	0.318	0.680	**0.876**	
RS	0.156	0.087	-0.195	0.278	0.498	0.435	0.616	0.508	**0.880**

* Discriminant Validity: square root of AVE

4.3. Exploratory Factor Analysis

To examine the degree of relationship between observed variables and the ultimate latent constructs, exploratory factor analysis was performed using SPSS. A principal component analysis of factors with varimax rotation is conducted to verify the basic structure of the research model. Exploratory Factor Analysis (EFA) is a technique used to spot the relationship between measured variables. It provides indications of the strength and direction of a factor on a measured variable(Hair et al., 1998). <Table 3> shows the rotated component matrix.

<Table 3> Rotated Component Matrix

Variables	Components							
	1	2	3	4	5	6	7	8
RA1	.209	-.025	**.892**	.226	.056	-.030	-.102	.094
RA2	.217	-.041	**.882**	.124	.137	.083	-.128	.119
RA3	.234	.081	**.904**	.104	-.016	.002	-.010	-.036
CX3	.090	-.138	-.020	-.098	.064	-.089	**.858**	.097
CX4	-.059	-.048	-.165	.001	.160	-.156	**.817**	-.086
CO1	**.734**	.215	.393	.264	-.080	.006	.195	.015
CO2	**.840**	-.041	.186	.162	.146	-.007	-.053	.211
CO3	**.785**	.100	.221	.115	.278	.119	.013	.213
CO4	**.756**	.122	.210	.047	.356	.100	-.045	-.304
TR1	.138	.284	.053	.173	.060	**.857**	-.142	-.091
TR2	.001	.138	-.008	.153	.072	**.890**	-.141	.173
SC1	.084	.189	.125	**.931**	.013	.094	-.064	.018
SC2	.252	.188	.186	**.860**	.145	.117	.056	.018
SC3	.121	.159	.175	**.867**	.113	.171	-.121	.140
GS1	.257	.475	.284	.192	.342	.138	.119	**.527**
GS2	.369	.387	.256	.261	.350	.184	-.041	**.567**
PB1	.234	.278	.042	.076	**.800**	.168	.102	.120
PB2	.236	.247	.079	.139	**.849**	-.031	.195	.065
RS1	.091	**.881**	-.002	.162	.187	.184	-.055	-.035
RS2	.014	**.908**	.025	.168	.108	.131	-.020	.061
RS3	.116	**.769**	-.037	.182	.229	.130	-.241	.184
Eigenvalue	7.775	2.989	2.339	1.552	1.195	1.121	1.072	1.013
% Variance	37.022	14.231	11.138	7.390	5.689	4.608	3.724	2.958
Cumulative Variance	37.022	51.253	62.391	69.781	75.470	80.078	83.801	86.760

* Method of Extraction: Principal Component Analysis.
Method of Rotation: Varimax with Kaiser Normalization.
Converged in 7 iterations.

4.4. Hypotheses Testing Results

Linear regression were used to calculate significance estimates and verify our hypotheses. <Tables 4 and 5> show results of the regression analysis. <Table 4> shows the estimates and significance of the factors that have direct effect on cloud adoption in the government: relative advantage, complexity, compatibility, technology readiness, security concern government support, perception of benefits and regulatory support. Significance level or p-value indicates how well the independent factor correlates with the dependent one. A factor is said to be accepted and have an influence on the dependent factor if the significance level is less than 0.05, and less than 0.1 is also acceptable(Hair et al., 1998). We found that 3 factors: complexity, technology readiness and regulatory support were rejected (p>0.05) (See <Table 4>).

<Table 4> Hypothesis Testing: Direct influence

Constructs	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	15.669	.189		82.689	.000
Relative Advantage	2.741	.190	.756***	14.403	.000
Complexity	.213	.190	.059	1.118	.266
Compatibility	.626	.190	.173**	3.291	.001
Technology Readiness	-.133	.190	-.037	-.697	.487
Security Concern	.721	.190	.199***	3.789	.000
Government Support	.567	.190	.156**	2.979	.004
Perception of Benefits	.608	.190	.168**	3.197	.002
Regulatory Support	.138	.190	.038	.724	.471

*** p<0.001; ** p <0.01; Dependent Variable: CA

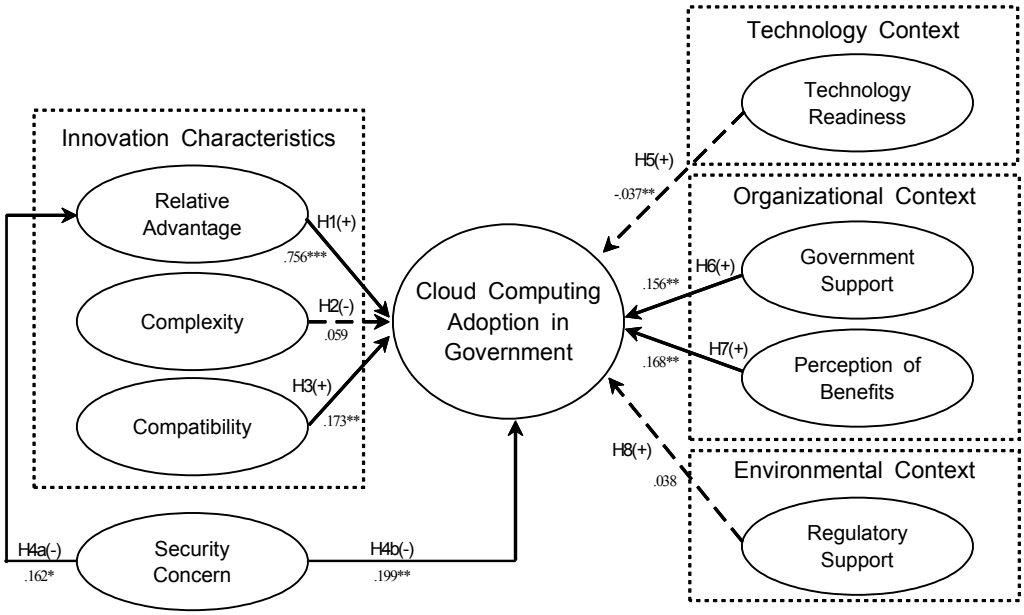
<Table 5> shows the regression result of security concern to the dependent factor relative advantage. Although the result shows a weak significance effect of security concern (<H4a>) on relative advantage p-value .080, it's accepted (p<0.1). Therefore security concern negatively influences relative advantage and therefore (<H4a>) is confirmed.

<Table 5> Hypothesis Testing: Indirect influence

Constructs	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	15.856	.379		41.882	.000
Security Concern	.671	.380	.162*	1.765	.080
* p<0.1, Dependent Variable: RA					

The hypotheses: relative advantage (<H1>) (p<0.001), compatibility (<H3>) (p<0.01), security concern (<H4b>) (p<0.001), government support (<H6>) (p<0.01) and perception of benefits (<H7>) (p<0.01) were confirmed. Security concern shows that it has direct and indirect effect

on cloud adoption in the government, therefore (<H4a>) and (<H4b>) were also confirmed. On the other hand, the hypotheses: complexity (<H2>), technology readiness (<H5>) and regulatory support (<H8>) were statistically insignificant and therefore were not confirmed. <Figure 2> summarizes the results of hypotheses and shows the factors that are supported with solid arrows along with their estimates, and those not supported with dashed lines.



Note: ***p < 0.001; **p < 0.01; and *p < 0.1

<Figure 2> Summary of Research Model Test Results

5. Discussion and Conclusion

5.1. Discussion

Having a clear picture about the factors that affect the adoption of cloud in the government is very important in order to build a better adoption strategy. This study aimed to look into the factors that affected the adoption of cloud in the public sector in Yemen. A combination of DOI theory and TOE framework were used to develop the research model.

The research findings show that five factors have direct influence on the adoption of cloud technology in the government: relative advantage (RA), compatibility (CO), security concern (SC), government support (GS) and perception of benefits (PB). Security concern also shows indirect influence on cloud adoption in government through influencing the independent factor: relative advantage. The other factors: technology readiness, complexity and regulatory support show insignificant effect on cloud adoption.

Relative advantage (<H1>) confirmed to have a positive influence on cloud adoption in the government. The result is also confirmed in previous studies in the literature, though most of them were conducted in private sector. Respondents recognize the relative advantage of cloud computing in terms of economic value, quality and productivity of business operations, and new business opportunities. They highly emphasized advantages of cloud and the worthiness of adopting such technology in government organizations.

Complexity (<H2>) was not confirmed to have an influence on cloud adoption in the government. Previous studies looked at cloud technology like any other disruptive technology and there is a level of complexity associated with it. In our study, it's possible that respondent don't have knowledge about the technical details of cloud technology. Another possible explanation to justify rejecting (H2) could be that respondents don't look at cloud technology as a complicated one and therefore it would have no influence on cloud adoption.

Compatibility (<H3>) is accepted. Compatibility with existing infrastructure is considered as one of essential factors in the process of adoption decisions. Therefore, it's extremely important to consider the compatibility of the cloud with the existing infrastructure.

Security concern (<H4a>) and (<H4b>) are accepted. Security concern indicated that it has an influence on

relative advantage and cloud adoption. Similar studies also confirmed a direct effect of security concern on the adoption of technology. However, Oliveira et al. (2014) didn't confirm the effect of security concern on relative advantage when he studied cloud adoption in the private sector, although security is a hot issue of cloud and more likely to diminish its relative advantage. Respondents commented that if anything would significantly impede the adoption decision, it would be the issues of security associated with it. This emphasize that security of cloud is still big issue.

Technology Readiness (<H5>) is rejected and respondents were unable to evaluate the current status of government organizations in terms of technology infrastructure because most of them don't work for government and therefore they don't have sufficient information about technology readiness of government organizations. As we pointed out before in section 4, there is high percentage of computer illiterate among government employees which led to having less clear picture about the current status of government organizations. Respondents commented that there is a duplicate in procurements of IT hardware and software which leads inefficient use of resources in some government organizations, while other organizations lacks IT infrastructure. They also pointed out that networking infrastructure is one of the key problems in government offices since cloud computing relies heavily on the network infrastructure.

Government Support (<H6>) is confirmed to influence cloud adoption in government. Previous studies also show that top management support has a strong influence in the adoption of technology. In the context of government, a strong commitment and persistence from political leaders to push the adoption process toward success is very crucial. It's also found that the corruption rate is very high in Yemen, therefore leadership with support from politicians is critical to persistence and sustainability of the adoption of cloud.

Perception of Benefits (<H7>) is also confirmed to influence cloud adoption in government. Barth (2015) confirmed that perception of benefits have a significant and positive effect on cloud adoption in government. Further analysis also showed that government leaders and employees lack a clear understanding and perception of the benefits of adopting cloud technology in government due to high percentage of computer illiteracy. Respondents commented that the lack of awareness of government employees is a big issue.

Regulatory Support (<H8>) is rejected, though the existence of legal framework can provide protection of organizations' data and therefore encourage adoption of cloud by both public and private sectors. It is well-known that lack of regulations has a negative and significant effect on cloud adoption(Barth, 2015). There is a consensus among respondents that there is no laws and regulations regarding cloud computing technology, or at least they are not enough to provide legal protection for cloud consumers. However, the reason behind rejecting this hypothesis might be because of the respondents' limited knowledge about cloud architecture and the issues related to it.

It seems that the rejected factors: complexity (<H2>), technology readiness (<H5>) and regulatory support (<H8>) have one thing in common: they're related to evaluating the current status of government organizations, in which the majority of respondents were unable to tell because they are not government employees. Moreover, most government employees have a very limited knowledge about cloud technology.

5.2. Conclusion

This study investigated the factors that influence the cloud adoption in government organizations in Yemen. The research model is derived from DOI theory and TOE framework. A sample of 118 respondents form Yemen were surveyed to evaluate our hypotheses. The results indicated that five factors have direct influence on cloud adoption: relative advantages, compatibility, security concerns, government support and perception of benefits. Security concern also shows a direct influence on relative advantage.

From all the previous results and discussions, we developed a proposition of some high level steps toward successful adoption of cloud technology in the government of Yemen:

- Setting up cloud infrastructure and network connectivity.
- Develop a legal framework to regulate cloud computing technology.
- Conduct awareness programs to managers and employees of the public sector.
- Develop a highly skilled technical team.
- Adoption of Government Integrated Data Center (GIDC).
- Reform and standardize business processes in government organizations.
- Develop an interoperability framework.
- Adopt cloud models gradually.

The experience of Government Application Store or Cloud Store(Nedev, 2014), implemented in some counties, is worth benchmarking to deliver high level of standardization of IT services and applications in the government and therefore enhance interoperability and harmonization among government organizations. Many advantages can be gained out of building a government application store.

Adopting cloud computing in government organizations will undoubtedly result in a huge transformation of the way that government organizations use to deliver their services. It will also push the whole-of-government transformation of e-Government services in a well-organized, standardized and integrated way. In addition, adoption of cloud computing will also help eliminate unnecessary capital investments on IT

within government organizations. The benefits and value expected from adopting cloud in the government will be tremendous and worth investing in it.

5.3. Limitations and further research

It was quite challenging to survey more government employees because most of them were computer illiterate and harder than that was finding government employees with knowledge about cloud computing. As a result the study delivered somehow less accurate information about some factors that are considered to be accepted: technology readiness and regulatory support. Respondents seemed to lack information about government organizations so that they were unable to evaluate the current status in terms of assessing technology and regulatory readiness. There is also a high possibility that some respondents didn't have enough knowledge of cloud technology. Therefore less accuracy of the data collected affected the validity of some factors and hypotheses.

Further studies should explore more in depth quantitative and qualitative investigations of what could affect the adoption of cloud in the public sector and accurately assess the current status in order to develop a clear strategy toward moving to the cloud. They should also take into account the sample to be surveyed to avoid misleading results and ensure the validity of the research model.

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