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Factors influencing cloud computing adoption for e-government implementation in developing countries: Instrument development

Fathey Mohammed Othman Ibrahim Norafida Ithnin

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Fathey Mohammed
Department of Information Systems, Faculty of Computing, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia and Department of Information Technology, Faculty of Engineering and Information Technology, Taiz University, Taiz, Yemen, and
Othman Ibrahim and Norafida Ithnin
Department of Information Systems, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

Abstract

Purpose – This paper aims to develop a model and measurement to investigate the factors influencing cloud computing adoption as a part of developing countries' alternatives to implement e-government services.

Design/methodology/approach – This study proposes a theoretical model based on the literature of technology adoption models. It constructs scale measurements for the proposed model constructs by extracting and adapting the items from the literature. The authors verify the scales' content validity and reliability by applying face validity, pre-testing and pilot study. For the pilot study, the authors collect the data from 26 information technology staff in five public organizations in Yemen. The authors test the reliability of the scales using Cronbach's alpha criterion, and then conduct exploratory factor analysis to evaluate the validity of the scales.

Findings – The results show that the scale measurements meet the conventional criteria of reliability and validity.

Originality/value – Theoretically, this paper provides an integrated model for examining cloud computing adoption for e-government implementation in developing countries. In addition, it develops an instrument to empirically investigate the influencing factors of cloud computing adoption in the context of developing countries' e-government initiatives.

Keywords Developing countries, Adoption, Cloud computing, e-government, Measurement

Paper type Research paper

1. Introduction

Electronic government (E-government) is considered as a tool to modify the concept of governance resulting in the citizens' participation, transparency in public functions and efficiency in public service delivery (OJO, 2014). Governments over the world recognized the potential opportunities offered by information and communication technology (ICT) to increase efficiency in internal processes and offer better services to citizens.

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Consequently, governments that ignore the value of the emerging ICT technologies may suffer crucial competitive disadvantages. However, e-government implementation is costly, involves enormous risk and requires skilled technical resources and a stable technical infrastructure (Ebrahim and Irani, 2005). On the other hand, there is a lack of readiness for e-government in many developing countries because of lack of resources, poor technology infrastructure, lack of ICT skills and low level of education and literacy (Gant, 2008; Kanaan, 2009). ICT infrastructure, human resources and financial resources are the most critical challenges and obstacles for e-government in developing countries (Al-Rashidi, 2013; Rana *et al.*, 2013). In addition, recent reports from the United Nation (UN), International Telecommunication Union (ITU), World Economic Forum (WEF) and Economist Intelligence Unit (EIU) show that many of developing countries have low indices in relation to ICT infrastructure, human capital and connectivity (E.I. Unit, 2010, ITU, 2012; Zukang, 2012; Bilbao-Osorio *et al.*, 2013). In consequence, e-government implementation requirements are difficult to be met in these countries. Therefore, e-government in many developing countries has not delivered the promise of more efficient and effective public services, and governments still struggle with the problems of ineffective business processes because of insufficient use of ICT (Shareef *et al.*, 2010; Wang and Hou, 2010; Al-Rashidi, 2013).

Therefore, for developing countries – more specific, countries that still in the early stages or those that have not begun e-government project yet – while they invest in ICTs to implementing e-government systems, there is an increasing need to exploit the opportunities created by the new emerging ICT technologies and paradigms. Governments can realize the potential benefits of new emerging technologies and turn to technology innovations as a way to overcome their challenges. Cloud computing is fueling the innovation in service delivery platforms and underlying networking infrastructures. It may bring a lot of opportunities to deliver user perspective and cost-effective new services.

Cloud computing can provide a good basis to hope that some of the traditional challenges can be addressed. It may make a revolution in e-government systems, in terms of cost saving, and actual and professional use of resources (Bansal *et al.*, 2012; Galal-Edeen, 2012; Alshomrani and Qamar, 2013). Further, cloud computing recently has created a revolution in the way ICT is used by organizations and individuals, and cloud-based application in the public sector already has established its effectiveness in meeting the requirements and the unexpected needs of resources (Tripathi and Parihar, 2011). Cloud computing has key characteristics and feasible features that make it proper for use in an e-government implementation. Gartner predicts that 20 per cent of the government agencies use cloud computing to be more effective. Further, because of its advantages, many countries have launched cloud computing for e-governance (Sharma *et al.*, 2012). Governments are seeking to enhance their own ICT infrastructure and reduce ICT cost by using cloud services. Many governments around the globe are introducing moving to the cloud computing as a tool of improving services, reducing costs and increasing effectiveness and efficiency in the public sector (Kurdi *et al.*, 2011). Several examples show that cloud computing has become a strategic direction for public sector organizations and is already being adopted in critical domains of the government's information technology (IT) infrastructure in the world. For example, USA.gov which is the main federal government information portal in the USA adopted a cloud-based solution (Terremark's Enterprise Cloud service) to overcome some issues such as massive network traffic load, long downtime and delays and inefficient services. Terremark's Enterprise Cloud service accounted to be the proper option to handle these problems because cloud computing can deal with on-demand scalability. The migration to the cloud helped General Services Administration (GSA) in reducing the site upgrade time from nine months to one day. Furthermore, the downtime has been reduced by 99.9 per cent. Additionally, in terms of costs, GSA saved 72 per cent annually by moving to the cloud (Kundra, 2010).

In the literature, there are relatively few studies investigated cloud computing in the context of e-government. Most of these studies mainly discussed the benefits and challenges of cloud computing to e-government, while very few studies proposed a model or a framework to explore factors influencing cloud computing adoption for e-government services implementation (Killaly, 2011; Li *et al.*, 2013; Shin, 2013; Trivedi, 2013; Kuiper *et al.*, 2014; Abeywickrama and Rosca, 2015; Sallehudin *et al.*, 2015). In the context of developing countries, exploring the factors that consider the cloud computing characteristics and the e-government implementation barriers can have significant value in cloud computing adoption for e-government implementation. It can help policymakers in these countries successfully adopt cloud computing for e-government service providing. This study proposes a model to explore the factors influencing governments in developing countries to adopt cloud computing for e-government services provision. Moreover, an instrument to measure the proposed factors is developed and validated. The following section reviews the literature on the cloud computing concepts, its applications in the e-government environment and the factors that may influence its adoption for e-government implementation. The next section is allocated to discuss the theoretical proposed model and its constructs. Next, the instrument is described and validated. Finally, the paper ends with the results discussion and conclusion.

2. Literature review

2.1 E-government challenges in developing countries

For developing countries, it is crucial to understand the major problems and challenges that might cause e-government project failure. Heeks (2003) and Dada (2006a, 2006b) reported that the low level of e-government services adoption largely because of the high level of failure of e-government projects and low level of functionality in developing countries. One reason that might contribute to the e-government failure in developing countries is the lack of appropriate ICT infrastructure (Ismail, 2008). Development of e-governments has a direct proportional relation with the ICT infrastructure required to execute e-government systems. However, many developing countries do not have the necessary infrastructure to deploy e-government services to cover the whole country (Basu, 2004, LiaquatAli and Venkat Sunitha, 2007). ICT infrastructure includes basic access infrastructure which consists of telephone lines, personal computers, internet access and penetration in rural areas, the speed available for the public to access the internet and the cost of the services provided in comparison to citizens' income. It also includes issues related to liability of networks and the availability of communication companies that support different services such as satellite communications in rural areas (Ndou, 2004). Furthermore, many developing countries cannot deploy the required infrastructure for e-government deployment (Ndou, 2004).

In addition, Heeks (2003) and Dada (2006a, 2006b) argued that the challenges to adopting e-government include ICT infrastructures, internal resources, legislation and policy issues and digital divide. Further, Ndou (2004) presented seven main barriers for e-government implementation in developing countries: ICT infrastructure, human capital, change management, strategy, policy issues, leadership role and partnership and collaboration. Moreover, Gichoya (2005) and Shin (2008) argued that e-governments in developing countries may face fundamental obstacles such as lack of basic IT infrastructures, appropriate IT applications and IT experts. Shin (2008) found that to achieve successful e-government implementation, developing countries need to fulfill certain unique requirements, in addition to satisfy the conditions similar to that are required for developed countries. Financial resources, organizational culture, GDP per capita and political stability are determining factors considered to be unique challenges in developing countries (Shin, 2008). Gichoya (2005) also concluded that, for developing countries, resource allocation factors like technologies, financial resource and skilled personnel may be more important than other factors. Likewise, it is unlikely to gain successful outcomes from the e-government implementation with insufficient technical, financial and human resources (Shin, 2008).

Furthermore, Rana *et al.* (2013) reviewed and analyzed relevant 78 research paper studying the barriers, challenges and critical success factors for e-government implementation. They concluded that technological barrier, poor management, lack of resources, lack of awareness, legal barriers and lack of ICT infrastructure are the most commonly experienced supply-side challenges and barriers for developing and less developed countries. As shown in Table I, the most critical challenges and obstacles for e-government in developing countries are ICT infrastructure, human resources and digital illiteracy and financial resources. Therefore, it is essential to assess the level of technologies, ICT infrastructure and human resources to identify a country's capacity and willingness to adopt the e-government.

2.2 Cloud computing

According to a widely accepted definition of the US National Institute for Standards and Technology (NIST), cloud computing is a model for providing ubiquitous, adequate and on-demand network access to a shared pool of configurable computing resources (e.g. servers, networks, storage, applications and services) with minimal effort and service provider interaction (Mell and Grance, 2011). NIST describes five characteristics for cloud computing: broad network access, on-demand self-service, resource pooling, measured service and rapid elasticity. Jadeja and Modi (2012) interprets these characteristics to the following benefits:

- Users access the information and services via the internet regardless of the device used and the user's location (virtualization).
- Ease of implementation (less IT skills are required).
- Service reliability (by the use of multiple sites).
- Efficient use of the infrastructure by sharing resources between a large range of users.
- Easier maintenance (no need to install applications on each user's computer).
- Pay per use (the usage of application per client is measured on regular bases).

Reference	Challenges							
	ICT infrastructure	Legislation & Policy issues	Human capital and digital illiteracy	Change management	Strategy	Financial and internal resources	Leadership role	Partnership and collaboration
World Bank (2003)	✓		✓			✓		
Heeks (2003)	✓	✓	✓			✓		
Ndou (2004)	✓	✓	✓	✓	✓		✓	✓
Gichoya (2005)	✓		✓			✓		
Ebrahim and Irani (2005)	✓		✓		✓	✓	✓	
Dada (2006a, 2006b)	✓	✓	✓			✓		
Ghavamifar (2008)	✓		✓					
Ismail (2008)	✓		✓					
Shin (2008)	✓		✓			✓		
Al-Sobhi and Weerakkody (2010)	✓		✓					
UN, 2012	✓		✓			✓		
Al-Rashidi (2013)	✓			✓	✓	✓	✓	
Rana *et al.* (2013)	✓	✓	✓			✓	✓	

Table I.
E-government challenges in developing countries

- Scalability (performance can be controlled).
- Security (providers are able to assign resources to solve security problems).

On the other hand, cloud service model is considered as a service-oriented architecture that describes cloud services at several levels of abstraction (Mell and Grance, 2011). These models are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS is a model in which cloud service providers (CSP) run and maintain computing resources, operating system and application software. However, in the PaaS model, CSP is responsible only for providing, running and maintaining system software and computing resources. On the other hand, in the IaaS model, CSP provides a set of virtualized computing resources (e.g. storage capacity, processing power, memory and network bandwidth) to the customer, while the customer runs and maintains the operating system and the software applications using these virtual recourses.

In addition, to deploy cloud computing services, there are four primary models: public, private, hybrid and community (Mell and Grance, 2011). Public cloud is a model by which the services are delivered on a network that is open for public use. The cloud environment is publicly accessible and various enterprises can be used to deliver the services to users. In the private cloud, cloud infrastructure is allocated only for a single organization, whether managed by the organization or by a third party, and hosted internally or externally. It is on premise cloud owned or/and managed by an organization to control cloud services and infrastructure. On the other hand, hybrid cloud comprises both public and private cloud models, so some resources are hosted and controlled externally by a third party, and some sources are used only by the organization. Finally, in the community model, resources are shared between several related organizations in the same community with similar concerns and requirement (Mell and Grance, 2011).

2.3 Cloud computing and e-government

For e-government, cloud computing characteristics mean that the effective use of this technology is useful in the way of implementing effective e-government services. Cloud computing has feasible features that make it proper for use in e-government implementation. Realizing cloud computing benefits for e-government may make a revolution in e-government applications in terms of cost saving, scalability of infrastructure, ease of implementation, accessibility, massive storage capacity, access to IT capabilities, elimination of procurement and maintenance and electricity consumption (Bhardwaj *et al.*, 2010; Rastogi, 2010; Chandrasekaran and Kapoor, 2011; Das *et al.*, 2011; Sharma and Thapliyal, 2011; Liang, 2012; NASR *et al.*, 2012; Sharma *et al.*, 2012). Public sector organizations can easily deploy cloud computing without the need to have heavy hardware, buy software licenses or implement applications (Alshomrani and Qamar, 2013; Bellamy, 2013). Organizations can save or even eliminate ICT capital costs and decrease operational costs by paying only for the used services and reducing or redeploying ICT staff (Bansal *et al.*, 2012; Alshomrani and Qamar, 2013; Bellamy, 2013). When loads increase, organizations need not to fulfil additional hardware and software, but can instead add and subtract network load capacity (Tripathi and Parihar, 2011; Zwattendorfer and Tauber, 2013). Cloud computing can increase staff mobility by enabling access to information and services from anywhere and with a wide range of devices (Sharma *et al.*, 2012; Zwattendorfer and Tauber, 2013). It allows smaller organizations to access powerful hardware, software and ICT staff (Bansal *et al.*, 2012; Liang, 2012; Bellamy, 2013; Zwattendorfer and Tauber, 2013). Cloud computing can make it easier to reduce or shed functionalities like running data centers and developing and managing software applications, allowing organizations to focus on critical issues like policy development and public services design and delivery (Kundra, 2010; Yeh *et al.*, 2010; Sharma *et al.*, 2011). Cloud computing is good for the environment, as it uses less resources. So, it requires very less power consumption (Kundra, 2010; Das *et al.*, 2011; Bansal *et al.*, 2012; Sharma *et al.*, 2012).

However, using cloud computing like other internet applications has some challenges. Many challenges of cloud computing for e-government implementation come from its newness and the relative development of the market for cloud services. There is a lack of standards when using and implementing cloud computing. Cloud users should be able to change between cloud service providers with a minimum of risk and cost. Accordingly, governments may need to adopt open standards policies for the cloud (ATSE, 2010). Many governments decided to use ICT systems that consistent to open standards to save the costs, or that can take place when using nonstandard systems (Yeh *et al.*, 2010, Liang, 2012). One area of significant concern for governments is the security and privacy of information held in cloud computing environments. Special attention must be given when adopting cloud computing to process information that is vital to national security, to maintain public trust in government or to manage critical government functions (Yeh *et al.*, 2010; Liang, 2012; Mukherjee and Sahoo, 2012; Sahu and Tiwari, 2012; Alshomrani and Qamar, 2013). Rising risk of losing data because of improper backup or system failures which are out of user control, make assuring business continuity another challenge to be concerned. Thus, governments need to understand the business continuity risks and be assured that effective measures such as service-level agreement (SLA), strong contracts, disaster recovery and business continuity plans are in place, especially if using offside cloud services (Craig *et al.*, 2009; Liang, 2012; Sahu and Tiwari, 2012; Alshomrani and Qamar, 2013). Further, because cloud computing services rely completely on the availability and speed of the internet as a carrier between consumer and service provider, speed and availability will be an issue (Sahu and Tiwari, 2012). Additional challenges such as leadership, need to establish an appropriate strategy and need for a range of new laws, rules and policies should be considered (Kundra, 2010; Yeh *et al.*, 2010).

Consequently, exploring the factors that consider the cloud computing characteristics and the e-government in developing countries can be highly significant. It can help policymakers in these countries successfully adopt cloud computing for e-government service providing. However, relatively few studies proposed a model or a framework to explore factors influencing cloud computing adoption for e-government services implementation (Killaly, 2011; Li *et al.*, 2013; Shin, 2013; Trivedi, 2013; Kuiper *et al.*, 2014; Abeywickrama and Rosca, 2015; Sallehudin *et al.*, 2015). Killaly (2011) adapted the Fit Viability Model (FVM) to help determine whether the Department of Defence (DoD) in the USA can implement cloud computing and if DoD is willing to implement this technology. Grounded on FVM, a new Viability-Willingness Model (VWM) was proposed. The VWM shows that the cost along with the organizational inertia, which is measured by motivation to learn and acceptance to use and the fit of the technology, leads to a perception of viability, which in turn leads to a perception of willingness to implement the technology. Trivedi (2013) applied technology, organization and environment (TOE) framework to propose a model for examining technological, organizational and environmental factors influencing cloud computing adoption by governments and large enterprises. The factors were identified from an analysis of case studies and the literature of the TOE framework. The proposed model helps organizations determine the capabilities they need to migrate to the cloud, and how much time it takes.

On the other hand, Shin (2013), grounded on the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM), proposed a theoretical model. The model integrates specific influencing factors such as availability, access, security and reliability with the existing TAM constructs. These factors are driven by some underlying perceived beliefs such as benefits, availability, access and security as enhancing constructs to predict user acceptance of cloud computing technologies. The model was empirically verified by investigating the perception of users working in public institutions. Results showed that user intention is influenced by the perceived features of cloud services. In addition, Li *et al.* (2013), by considering the practical issues of implementing cloud e-government, analyzed existing factors of e-government and proposed an influence a factor model of implementing e-government cloud in China. Based on the Gil-Garcia model, the influencing factors are categorized into 5 classes and 22 indicators. The cloud computing factor class comprises three indicators: security, complexity and skills. Project factor class includes business needs, maturity of existing systems, project size and implementation difficulty indicators. Subjective factors class comprises two factors managers' attitudes and behavior and ordinary people's attitude. The organizational environment class includes seven factors:

(1) business function;
(2) privacy concerns;
(3) management ability of information department;
(4) informatization plan;
(5) existing informatization level;
(6) one-year budgets; and
(7) autonomy of units.

Finally, the external environment factor class includes laws and regulations, policy and political pressures, development state abroad, degree of public support, push of superior departments and push of departments' indicators.

Kuiper *et al.* (2014) proposed a theoretical model based on the general diffusion of innovation (DOI) theory, and then examined it with empirical evidence. An inertia system diagram to model the European Commission perspective on public sector cloud adoption was described. Results show that factors such as collaboration, traceability and auditability; convincing IT managers, security and legal issues; perception of the term cloud; and risk besides innovation factors (relative advantage, compatibility, complexity, observability and trialability) influence the cloud adoption in the public sector. In addition, time-specific factors such as IT staff shortage, innovation squeeze, feelings, climate (energy use and emissions), culture, economy and politics are influencing factors. Abeywickrama and Rosca (2015) investigated how cloud computing enhances value in public service delivery by conducting a case study research on the Moldova central public administration. Based on DeLone & McLean information systems success model (D & M model), factors related to system quality, information quality, service quality, intention to use, use and user satisfaction were examined. The results revealed that system quality, information quality and service quality affect the intention to use, use and user satisfaction. Moreover, intention to use, use and user satisfaction affect the net values of cloud computing in the public administration of Moldova. Sallehudin *et al.* (2015) explored the possible factors that could influence cloud adoption decision in Malaysian public agencies. A theoretical model was developed by integrating the DOI and IT personnel characteristics. The developed model was tested to determine the factors influencing cloud computing adoption to enhance service delivery in the Malaysian public sector. The results showed that innovation attributes (relative advantage and compatibility) and the human factor (IT personnel knowledge) are factors effecting cloud computing adoption in the Malaysian public sector.

Moreover, Mohammed and Ibrahim (2015) reviewed the existing literature on the proposed models to migrate e-government services to the cloud. They critically analyzed and classified these models to different types. They concluded that there is a lack of studies that empirically examine the factors influencing adopting cloud computing for e-government implementations.

3. Organization-level information technology IT adoption theories

3.1 Organization environment framework (TOE)

The TOE framework was developed in 1990 (Tornatsky and Fleischer, 1990). It is an organization-level theory which explains how the organizational context influences the adoption and implementation of new technology (Baker, 2012). The model distinguishes between three building blocks determining the adoption of innovations: technology context, organizational context and environmental context. Several studies used the TOE framework to understand different IT adoptions, such as electronic data interchange (EDI), e-commerce and ERP. In addition, in the recent past years, there are some studies that examined this framework to investigate Cloud computing adoption (Borgman *et al.*, 2013).

3.2 Diffusion of innovation theory

DOI was proposed to explain the factors that affect the individuals' decision to adopt and use an innovation. However, it is used in information system (IS) research to help explaining the willing and the decision to adopt an innovation in organizations (Rogers, 1995). It has been used to understand different innovations' adoption in technology and information system (IS) research. Regarding cloud computing, this theory was mostly used with other theory/theories (Low *et al.*, 2011; Nuseibeh, 2011; Tan and Lin, 2012; Alshamaila *et al.*, 2013; Morgan and Conboy, 2013; Saedi and Iahad, 2013).

3.3 Fit-Viability Model

This model has been used specifically to address the adoption of a new technology. It was proposed by Tjan (2001) for evaluating organizational adoption of internet initiatives. It expands on the task–technology fit model to include two dimensions, fit and viability. The FVM integrates task–technology fit with the general belief of organizational viability of information technology (Liang and Wei, 2004; Liang *et al.*, 2007). Liang and Wei (2004) investigated the major factors that affect the outcome of m-commerce applications and identified the criteria that can be used to assess the suitability of m-commerce applications. For fit, criteria for measurement are identified based on task–technology fit theory, while for viability, financial and managerial criteria are identified.

4. The proposed theoretical model

The decision to use a new technology involves some risk. Therefore, developing a model that can predict the applicability of a new technology in a context will be valuable. The applicability of a technology or a system concerns not only the technological characteristics but also the readiness of the context. Therefore, FVM can be suitable as the base of the proposed theoretical model. It is specifically adapted to help determine whether cloud computing is a viable option for implementing e-government. The model aims to help in assessing the applicability of cloud computing for the purpose of e-government implementation in developing countries.

The fitness of a technology for specific task depends on the technology characteristics and the context. Consequently, different factors influence technology fit. For example, Goodhue and Thompson (1995) defined relationship, quality, timeliness, compatibility, locatability, reliability and authority as factors influencing the fitness of the technology with the tasks it supports. Lee *et al.* (2007) examined quality, locatability, authorization, production timeliness, compatibility, systems reliability, ease of use/training and relationship with users to measure the fitness of mobile commerce in the insurance industry. Timeliness and mobility were investigated by Liang *et al.* (2007) to assess the task–technology fit to study the adoption of mobile technology in business. However, reviewing the literature shows that a relation between factors like relative advantage (Nance and Straub, 1996; Lam *et al.*, 2007), compatibility (Goodhue and Thompson, 1995; Lam *et al.*, 2007; Lee *et al.*, 2007; Teo and Men, 2008), complexity (Lee *et al.*, 2007), Trialability (Lam *et al.*, 2007) and security (Zhou *et al.*, 2010) is defined. Thus, the fitness of cloud computing (as an innovation) for the e-government task requirements is proposed to be influenced by relative advantage, compatibility, complexity, trialability and security (Figure 1).

On the other hand, there are different factors that influence viability. Market-value potential, time to positive, cash flow, personnel requirement and funding requirement were defined by Tjan (2001) to measure the viability of organizations to adopt internet initiatives. Liang and Wei (2004) measured the viability of mobile technology adoption by examining economic, organization and IT infrastructure indicators. They identified asset specificity, uncertainty, usage frequency and project budget for assessing economic feasibility, process reengineering, top management support and user competence for organizational support measurement, and software and hardware, data management and the competence of IT staff for IT infrastructure readiness. Killaly (2011) considered the fit as a factor of viability in addition to organization inertia and cost. By considering the specific characteristics of public sector organizations, the viability of cloud computing for public e-services can be measured by specific indicators. Cloud computing, as a new concept with open standards, to be viable to implement e-government services may need more organizational support as well as an analysis of its economic feasibility and assessment of the organizations' technological readiness. From this standpoint, return on investment (ROI), asset specificity and uncertainty are proposed to affect the viability from the economical view of point, while

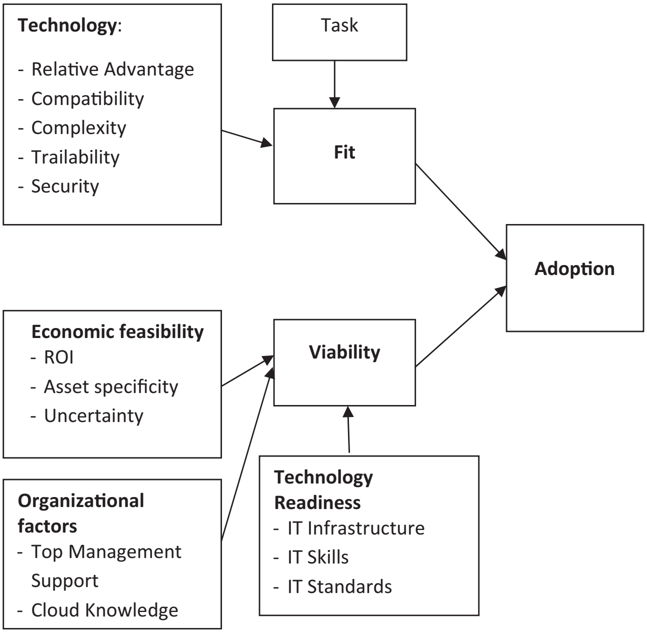

Figure 1.
The proposed model

top management support and cloud knowledge are from the organization perspective and IT infrastructure, IT skills and IT standards are from the technological readiness viewpoint. Figure 1 represents the proposed model. Following is a description of the main dimensions and related factors.

4.1 Fit

Fit is the extent to which a technology provides features that match the requirements of the task (Goodhue and Thompson, 1995; Lippert and Forman, 2006). In the current study context, fit is defined as the extent to which cloud computing is consistent with the specific requirement of e-government implementation. Accordingly, fit can be measured by defining the e-government implementation tasks and the innovative characteristics of cloud computing. *Task* refers to the task requirements within the organization (Liang *et al.*, 2007). Establishing online government services requires implementing and upgrading the e-government system to match task requirements that would otherwise be performed offline (United Nations, Department of Economic and Social Affairs, Division for Public Administration and Development Management, 2010; Krishnan and Teo, 2011). In the current study, task construct identifies the government-related requirements and actions that are performed to provide e-services. It examines government organization's computing needs to implement e-government services.

On the other hand, *Technology Characteristics* consider the technological factors influencing cloud computing adoption in the literature (Alshamaila, 2013; Morgan and Conboy, 2013; Rieger *et al.*, 2013; Tehrani, 2013a, 2013b; Fu and Chang, 2015). These factors include relative advantage, compatibility, complexity, trialability and security. *Relative advantage* is defined by Rogers (1995) as the degree to which an innovation is perceived as better than the idea it supersedes. Particularly, in the cloud computing adoption literature, relative advantage is defined as the degree to which decision-makers perceive cloud as being better than other computing paradigms (Nuseibeh, 2011; Tehrani, 2013a, 2013b). *Compatibility*, on the other hand, is defined as the extent to which the value of the innovation consistent with existing values, beliefs and the needs of potential adopter (Rogers, 1995). In the context of cloud computing adoption, compatibility refers to which extend cloud computing is perceived as consistent with the existing technology, skills and needs of companies (Morgan and Conboy, 2013; Tehrani, 2013a, 2013b). *Complexity*, as a factor of diffusion of innovation, was originally defined by Rogers as the degree to which an innovation is seen by a potential adopter as being relatively difficult to use and understand. Related to cloud computing, complexity refers to the degree to which cloud computing is perceived as being relatively difficult to understand and use (Alshamaila *et al.*, 2013; Tehrani, 2013a, 2013b). *Trialability* means that the diffusion of an innovation is influenced by the degree to which this innovation can be experimented with on a limited basis (Rogers, 2003). Tehrani (2013a, 2013b), Alshamaila *et al.* (2013), and Morgan and Conboy (2013) examined this factor in the context of cloud computing. In the adoption literature, more specific for the adoption of e-government solutions, security concerns have been indicated to be important (Conklin, 2007). *Security* can be defined as the ability to prevent unauthorized access or modification to information in storage, processing or transit (Joshi *et al.*, 2001). Regarding cloud computing technology, data security and privacy are the major concerns for adoption (Lian *et al.*, 2014). For governments, the security and privacy of information held in cloud computing environments is one of the most significant concerns.

4.2 Viability

Viability measures the extent to which the organizational infrastructure is prepared for adopting a technology (Liang *et al.*, 2007; Turban *et al.*, 2011; Larosiliere and Carter, 2013; Muhammad *et al.*, 2013). For the purpose of this study, viability measures the extent to which the public sector organizational environment is ready for cloud computing and the extent of the value-added potential of using cloud computing in e-government. This research measures the viability of cloud computing in the public sector organization by investigating economic feasibility, organization and technological readiness.

Economic feasibility refers to the degree to which the economic benefits of something to be made, done or achieved are greater than the economic costs. It determines whether a particular technology/application is cost-effective. This includes cost reduction and acceptable ROI. Hence, it includes two different aspects: ROI and transaction cost. *ROI* assesses the cost vs benefit of the particular IT project to see whether the investment can bring in adequate returns. On the other hand, if *transaction cost* reduces, the willingness to use a technology can increase. Factors influencing transaction cost may differ from one technology to another. For example, Liang *et al.* (2007) identified asset specificity, uncertainty and frequency in the context of mobile technology adoption, while employee training cost, compatibility cost and software/hardware maintenance cost are discussed by Turban *et al.* (2011) for collaboration 2.0 tools' adoption. For cloud computing adoption, asset specificity (Rieger *et al.*, 2013, Lian *et al.*, 2014) and uncertainty (Nuseibeh, 2011; Alshamaila *et al.*, 2013) have been identified as influencing factors.

Asset specificity identifies the assets that an organization may need to implement a system or adopt a new technology (Liang *et al.*, 2007). Lian *et al.* (2014) examined the costs of acquiring hardware and software and the costs of the integrating as influencing factors on cloud computing adoption in hospitals. In this research, asset specificity can be defined as the cost of physical (hardware, software, licensing and integrating) and human (training and consulting) requirements to successfully implement cloud computing in e-government services. On the other hand, *uncertainty* refers to the state in which the adopter has limited knowledge to describe the results of using a new technology (Knight, 1921). Liang *et al.* (2007) identified uncertainty as a factor economically influencing the viability of mobile technology for organizations. In relation to cloud computing, where data are stored and how these are handled increase the uncertainty. Alshamaila *et al.* (2013) and Nuseibeh (2011) examined the uncertainty as a negative factor of cloud computing adoption. Subsequently, the uncertainty of cloud computing in the public sector affects the transaction costs which economically influence the viability of this technology in the context of e-government implementation.

In addition, the readiness of an organization to implement a new system or adopting new technology is surely influenced by a set of *organizational factors*. *Top management support* (Ang *et al.*, 2002; Umble *et al.*, 2003) and IT knowledge (Poon and Wagner, 2001; Umble *et al.*, 2003) are factors of this type. Liang *et al.* (2007) examined user competence and top management support to measure the viability of mobile technology in the context of business organizations. Further, top management support and employee training were defined by Turban *et al.* (2011) to assess the readiness of an organization to adopt social networking. With respect to cloud computing, researchers investigate the effect of factors such as top management support, cloud knowledge and prior experience on private sector adoption of cloud computing (Low *et al.*, 2011; Tehrani, 2013a, 2013b). Therefore, top management support and cloud knowledge are considered as factors that examine the viability of cloud computing for e-government implementation.

Technological Readiness describes the organizational resources that influence the organization decision to adopt a new technology. Organizational resource includes IT infrastructure and IT staff (Zhu *et al.*, 2006; Pan and Jang, 2008, Oliveira and Martins, 2010; Wang and Hou, 2010). However, because there is a lack of standards when using cloud computing, governments need to promote endorsement of open standards for the cloud (ATSE, 2010). Low *et al.* (2011) studied the influence of technology readiness on cloud computing adoption decision by assessing the readiness in term of IT infrastructure and IT human resources. Tehrani (2013a, 2013b), Nuseibeh (2011), Borgman *et al.* (2013) and Nkhoma and Dang (2013) examined the impact of organizational readiness in terms of human resources knowledge about cloud computing on the adoption decision, legal and privacy issues. This study investigates the influence of technological readiness on the viability of cloud computing in terms of IT infrastructure, skills and policies.

5. Instrument development

By considering the theoretical constructs' literature, cloud computing characteristics and e-government context, an instrument is developed to measure IT experts' perspective of the fit and viability of cloud computing for e-government services. Following is a description of the instrument development and validation process.

5.1 Instrument design and scale development

The instrument is mainly built based on the constructs identified from the technology adoption theories (Diffusion of Innovation Theory and FVM) and cloud computing adoption literature. In addition, the context of the study, which is e-government implementation, is accounted. The developed questionnaire (as an instrument) consists of two parts to measure respondent's perception toward the two suggested dimensions of the proposed model: fit and viability. In each part, each question reflected a measurement construct under the correspondent dimension. The first part (technology fitness) uses diffusion of innovation constructs' measures to examine how much cloud computing matches with the tasks of e-government implementation. The second part (viability) is constructed from the items that measure the respondents' view regarding the extent to which their organization is ready for cloud computing. According to the proposed model and the literature, the viability of cloud computing for an organization is influenced by economic feasibility, organizational factors and technological readiness. Therefore, the scales of these factors should be identified.

To develop the instrument scales (items for each construct), the definition of each construct is reviewed based on the theories used and the literature. Then, the dimensions of each construct are identified. To measure each dimension, one item or more is adapted from the literature by considering the subject under investigation (cloud computing) and the context (e-government). The detailed list of constructs, their dimensions and number of items for each construct and related references is shown in Table II. All items that address constructs' scales in the model are based on a five-point Likert scale, where 1 is represented as strongly disagree and 5 represents strongly agree.

5.2 Validity and reliability

Validity is the degree to which an instrument measures what it claims to measure (Forzano and Gravetter, 2009). It allows the researcher to find out if the research fits the reality, and if the researcher is measuring what he really wants to measure (Churchill, 1979). On the other hand, reliability can be referred to as the degree to which an instrument can generate consistent results, meaning results free from measurement errors (Churchill, 1979). To reach the reliability and validity of the developed instrument, content validity, pre-testing and pilot study are used.

5.2.1 Content validity. To ensure the instrument content validity, five senior researchers assessed whether the items in each construct represent the entire range of possible items that should be covered. To facilitate the content validity assessment, a form was developed to allow the expert evaluate the following:

- Whether each item represents the concept domain.
- If the content domain adequately addresses all dimensions.
- If there are any style changes necessary in the wording of items.
- Do the items comprehensively represent the total content domain?

The expert can do that by assigning a number (1, 2 or 3) so 1 = The item is not representative, 2 = The item needs revisions to be representative and 3 = The item is representative. In addition, the expert is provided with space to give comments for each item and for the whole scale in each construct. The instrument was modified based on the comments from the experts.

Table II. Questionnaire items development based on literature

Construct	No. of Items	Dimensions	Reference
Task	3	Servicing citizens–Internal operations–Exchanging and sharing information	Killaly (2011) and Liang *et al.* (2007)
Relative advantage	5	Cost–Quality–Access to latest technology	Moore and Benbasat (1991), Alshamaila (2013), Espadanal (2012), Gupta *et al.* (2013), Ross (2010) and Tehrani (2013)
Complexity	5	Ease of Implementation–clarity–Easy to learn–Time	Moore and Benbasat (1991), Alshamaila (2013), Espadanal (2012), Ifinedo (2011) and Tehrani (2013)
Compatibility	5	Fit with work norms–Integrating with existing systems–Requiring for technical changes	Moore and Benbasat (1991), Alshamaila (2013), Espadanal (2012), Ifinedo (2011), Ross (2010) and Tehrani (2013)
Trialability	4	Trialing before actual use–adequacy of testing time–availability for trial	Moore and Benbasat (1991), Alshamaila (2013) and Tehrani (2013)
Security	5	Adequacy of security techniques–Data Protection–Data privacy and confidentiality	Tehrani (2013) and Hailu (2012)
Fit	5	Task requirements alignment–Systems adaptability–Alignment with computing needs	Killaly (2011), Zigurs and Buckland (1998), Baas and van Rekom (2010) and Goodhue (1998)
Top management support	5	Interest–leadership–engagement–commitment	Bennett and Savani (2011), Espadanal (2012), Ifinedo (2011), Shah Alam *et al.* (2011) and Lian *et al.* (2014)
Cloud knowledge	5	Basic knowledge (structure–types–models –requirements)–Understanding the benefits and challenges	Tehrani (2013)
ROI	6	Investment in new infrastructure–Time and effort–Maintenance costs - hiring IT expertise–Training costs	Espadanal (2012), Gupta *et al.* (2013) and Tehrani (2013)
Asset specificity	4	Need for special equipments/special expertise	Liang *et al.* (2007)
Uncertainty	3	Unpredictability of performance - unreliability–Ambiguity	Alshamaila (2013)
IT infrastructure	5	Necessary technical requirements - Internet connection–computational capabilities	Bennett and Savani (2011), Espadanal (2012), Killaly (2011) and Liang *et al.* (2007)
IT skills	5	Employees' IT literate/IT-related skills–IS/IT staff capabilities (analysis-implementation)	Bennett and Savani (2011), Espadanal (2012), Ifinedo (2011) and Liang *et al.* (2007)
IT standards	4	Security rules, policies–Privacy laws–Standard legislations–legal protection	Alshamaila (2013) and Espadanal (2012)
Viability	3	Sufficient of current resources–efficient transformation	Liang *et al.* (2007) and Killaly (2011)
Adoption	4	Recommending–Evaluating/Planning–initiating the applying process	Espadanal (2012) and Ross (2010)

5.2.1 Pre-test. Pre-testing is a process in which a small number of respondents were involved to complete and evaluate the instrument in terms of clarity, focus, simplicity, ambiguity of wording, vocabulary and grammar (Creswell, 2005). It helps determine whether respondents can understand the questions and complete the survey. For the purpose of this study, pre-testing was conducted to improve the validity and the clarity of the instrument. A sample of colleagues and experts from the real field was involved in this process. The researcher edited a number of statements based on feedback from the respondents. Further, some comments such as the length of the instrument were considered in the next stages of validation.

5.2.2 Pilot study. The pilot study is a small version of the final real data collection process in which the data are collected from a number of respondents of the real sample (Robson, 2002). By conducting the pilot study, the reliability of the instrument can be assessed, so measures from a scale may be recommended to be dropped to increase the reliability of the scale. For the purpose of this research, data were collected from IT staff in five public organizations in Yemen. An electronic version of the questionnaire using a five-point Likert scale was developed. The researcher contacted one of the IT experts in each targeted organization and sent him the link of the questionnaire and asked him to distribute it through their workmates. After two weeks, a reminder was sent to the participants to fill the questionnaire. After one month, 26 responses were received. For the purposes of reliability testing and further validating of the instrument scales, the collected data were coded and tabulated.

5.2.2.1 Reliability of scales. Reliability test was conducted to assess the internal consistency of the measures in each scale. Cronbach's alpha values' reliability coefficient test in SPSS was used to test the reliability. Table III shows the results. Researchers suggest 0.7 as the satisfactory cutoff for the Cronbach's alpha criterion. However, Hair

The construct	No. Items	Original Cronbach's alpha	Cronbach's alpha if an item is deleted	Items to be deleted
Task	3	0.717	0.717	0
Relative advantage	5	0.907	0.922	Adv5
Complexity	5	0.601	0.671	Complx4
Compatibility	5	0.770	0.798	Comp5
Trialabilty	4	0.657	0.734	Trial4
Security	5	0.926	0.926	0
Fit	5	0.714	0.757	Fit3
Top management support	5	0.961	0.961	0
Cloud Knowledge	5	0.897	0.916	Knwg1
ROI	6	0.720	0.745	ROI1
Asset specify	4	0.812	0.870	Asset4
Uncertainty	3	0.786	0.786	0
IT infrastructure	5	0.541	0.667	ITInfra1
IT skills	5	0.838	0.850	ITSkills5
IT policy	4	0.664	0.733	ITPolicy4
Viability	3	0.558	0.739	Viability3
Adoption	4	0.798	0.840	ADP4

Table III.
Reliability test

et al. (2006) consider the value of more than 0.6 as an acceptance level. As a result, some measures were dropped by considering scales' dimensions.

5.2.2.2 Validity of scales. For further ensuring the instrument validity, the validity and the undimensionality of the scales was assessed using exploratory factor analysis (EFA) (Pett *et al.*, 2003; Thompson *et al.*, 2004). Using SPSS 20, EFA with principle component factor analysis and varimax rotation was conducted. For each scale, adequacy for factor analysis (Kaiser-Meyer-Olkin [KMO] and Bartlett's test of sphericity), eigenvalue and factor loading was examined. KMO and Bartlett's test of sphericity are examined to check whether the data set is appropriate for factor analysis. Eigenvalue indicates the number of components in a scale which should be one to achieve the validity of the scale. Further, for undimensionality of the scale, the items within this scale should be highly loaded. The cutoff values for these criteria with the corresponding sources are represented in Table IV. Scales were analyzed one by one, and the results are discussed. For the testing of data appropriateness for factor analysis, results show that all KMO values are above 0.5, ranging from 0.500 to 0.790, except for trialability construct which has 0.452 KMO value. However, Bartlett's test for all constructs was significant. Thus, we consider that the data are appropriate for factor analysis. Table V represents the KMO and Bartlett's test for all constructs.

On the other side, factor analysis results show that by testing eigenvalues, one component is identified for each construct (scale) except for complexity, ROI and IT infrastructure. For the complexity, two components were identified with eigenvalues 2.273 and 1.028. In addition, two components were identified for both ROI and IT infrastructure with eigenvalues 2.513, 1.124, 2.007 and 1.354. Table VI shows the eigenvalue testing results for all scales. This means that the items in each of these scales (complexity, ROI and IT infrastructure) may not measure one factor. Therefore, there is a need to drop one or more items of each of these scales to increase their validity. Assessing factor loading may help determine problematic items.

For scales with one component, factor loading results in values exceeding the cutoff level of 0.4 which confirms the validity of the scales (Table VII). However, factor loading

The criterion	Satisfactory level	Sources
KMO	>0.5	de Vaus (1993), Field (2005)
Bartlett's Test of Sphericity	< 0.05	Hair *et al.* (1995), Tabachnick and Fidell (2007)
Eigenvalue	>1	Kaiser (1960)
Factor loading	>0.4	De Vaus (1993), Field (2005) and Hair *et al.* (1995)

Table IV. Factor analysis criteria cutoffs

Data adequacy tests	TASK	ADV	COMPLX	COMP	TRIAL	SEC	FIT	ROI	ASSET
KMO	0.595	0.512	0.599	0.666	0.452	0.764	0.696	0.534	0.700
Bartlett's test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	UNCERT	TMS	KNLG	IT-INFRA	IT-SKILL	IT-POLICY	VIABILITY	ADP
KMO	0.668	0.730	0.751	0.530	0.790	0.633	0.500	0.562
Bartlett's test	0.002	0.000	0.000	0.000	0.000	0.001	0.001	0.000

Table V. KMO and Bartlett's test

The construct	Component	Initial eigenvalues Total	Initial eigenvalues % of variance	Initial eigenvalues Cumulative (%)	Extraction sums of squared loadings Total	Extraction sums of squared loadings % of variance	Extraction sums of squared loadings Cumulative (%)
Task	1	*2.011*	*67.020*	*67.020*	*2.011*	*67.020*	*67.020*
	2	0.732	24.400	91.420			
	3	0.257	8.580	100.000			
ADV	*1*	*2.772*	*69.292*	*69.292*	*2.772*	*69.292*	*69.292*
	2	0.841	21.022	90.315			
	3	0.294	7.343	97.657			
	4	0.094	2.343	100.000			
Complx	*1*	*2.273*	*56.814*	*56.814*	*1.674*	*41.846*	*41.846*
	2	*1.028*	*25.695*	*82.509*	*1.627*	*40.663*	*82.509*
	3	0.469	11.721	94.230			
	4	0.231	5.770	100.000			
Comp	*1*	*2.519*	*62.984*	*62.984*	*2.519*	*62.984*	*62.984*
	2	0.772	19.292	82.277			
	3	0.531	13.263	95.539			
	4	0.178	4.461	100.000			
Trial	*1*	*1.964*	*65.452*	*65.452*	*1.964*	*65.452*	*65.452*
	2	0.834	27.795	93.247			
	3	0.203	6.753	100.000			
Sec	*1*	*3.686*	*73.716*	*73.716*	*3.686*	*73.716*	*73.716*
	2	0.613	12.258	85.975			
	3	0.456	9.125	95.100			
	4	0.146	2.927	98.027			
	5	0.099	1.973	100.000			
Fit	1	*2.364*	*59.108*	*59.108*	*2.364*	*59.108*	*59.108*
	2	0.835	20.864	79.972			
	3	0.449	11.214	91.186			
	4	0.353	8.814	100.000			
TMS	*1*	*4.024*	*80.473*	*80.473*	*4.024*	*80.473*	*80.473*
	2	0.464	9.280	89.753			
	3	0.266	5.310	95.063			
	4	0.181	3.626	98.689			
	5	0.066	1.311	100.000			
Knwg	*1*	*2.722*	*68.049*	*68.049*	*2.722*	*68.049*	*68.049*
	2	0.629	15.717	83.765			
	3	0.439	10.964	94.730			
	4	0.211	5.270	100.000			
ROI	*1*	*2.513*	*50.254*	*50.254*	*2.513*	*50.254*	*50.254*
	2	*1.124*	*22.474*	*72.728*	*1.124*	*22.474*	*72.728*
	3	0.778	15.567	88.295			
	4	0.486	9.718	98.013			
	5	0.099	1.987	100.000			
ASSET	*1*	*2.387*	*79.574*	*79.574*	*2.387*	*79.574*	*79.574*
	2	0.433	14.433	94.006			
	3	0.180	5.994	100.000			

Table VI.
Eigenvalue testing

(*continued*)

The construct	Component	Initial eigenvalues Total	% of variance	Cumulative (%)	Extraction sums of squared loadings Total	% of variance	Cumulative (%)
UNCERT	*1*	*1.952*	*65.057*	*65.057*	*1.952*	*65.057*	*65.057*
	2	0.608	20.263	85.320			
	3	0.440	14.680	100.000			
IT-INFRA	*1*	*2.007*	*50.170*	*50.170*	*2.007*	*50.170*	*50.170*
	2	*1.354*	*33.850*	*84.020*	*1.354*	*33.850*	*84.020*
	3	0.385	9.636	93.656			
	4	0.254	6.344	100.000			
IT-SKILL	*1*	*2.776*	*69.399*	*69.399*	*2.776*	*69.399*	*69.399*
	2	0.562	14.039	83.438			
	3	0.369	9.224	92.662			
	4	0.294	7.338	100.000			
IT-POLICY	*1*	*1.980*	*66.008*	*66.008*	*1.980*	*66.008*	*66.008*
	2	0.647	21.572	87.580			
	3	0.373	12.420	100.000			
VIABILITY	*1*	*1.603*	*80.156*	*80.156*	*1.603*	*80.156*	*80.156*
	2	0.397	19.844	100.000			
ADP	*1*	*2.307*	*76.892*	*76.892*	*2.307*	*76.892*	*76.892*
	2	0.578	19.269	96.161			
	3	0.115	3.839	100.000			

Note: Extraction method: principal component analysis; the italic data highlight the number of components in each factor according to the eigenvalues

Table VI.

of some items in the scales with two components (complexity, ROI and IT infrastructure) are less than 0.4 or loading highly on both components. By dropping these items, the scales become one component on the eigenvalue measure and highly loading on one factor. Table VIII shows the factor loading before item dropping (a) and after dropping the item/items (b).

6. Discussion

The results from the pilot study have provided initial support for the model constructs and instrument in the assessment of cloud computing adoption for e-government implementation. The reliability of the model constructs was established with all constructs having Cronbach's alpha coefficients greater than the recommended value of 0.6 (Hair *et al.*, 2006). On the other hand, the validity of constructs was established through the face validity with the academic experts and EFA analysis. The EFA results show that all constructs have a satisfactory level of validity except for complexity, ROI and IT infrastructure. The Appendix represents the original scales for all constructs. By eliminating problematic items (with low loading) in the scales of these construct, their validity is established. Following the comments and suggestions received from academic experts and respondents to the pilot questionnaire, as well as the analysis shown above, a final instrument has been designed for the proposed full-scale study.

Previous studies on technology adoption have emphasized the importance of assessing the viability of a technology for a context beside assessing its fitness to the

Items	Component 1
Relative Advantage 1	0.904
Relative Advantage 2	0.785
Relative Advantage 3	0.729
Relative Advantage 4	0.898
Compatibility 1	0.903
Compatibility 2	0.862
Compatibility 3	0.789
Compatibility 4	0.581
Trialability 1	0.800
Trialability 2	0.942
Trialability 3	0.661
Security 1	0.909
Security 2	0.859
Security 3	0.771
Security 4	0.939
Security 5	0.803
Fit 1	0.761
Fit 2	0.660
Fit4	0.839
Fit5	0.803
Adoption 1	0.774
Adoption 2	0.958
Adoption 3	0.888
Top Management Support 1	0.918
Top Management Support 2	0.919
Top Management Support 3	0.893
Top Management Support 4	0.893
Top Management Support 5	0.861
Knowledge 2	0.747
Knowledge 3	0.875
Knowledge 4	0.804
Knowledge 5	0.867
Asset 1	0.925
Asset 2	0.916
Asset3	0.833
Uncertainty 1	0.759
Uncertainty 2	0.843
Uncertainty 3	0.816
IT Skills 1	0.797
IT Skills 2	0.882
IT Skills 3	0.852
IT Skills 4	0.798
IT Policy 1	0.771
IT Policy 2	0.879
IT Policy 3	0.783
Viability 1	0.895
Viability 2	0.895

Table VII.
Factor loading for scales with one component

Items	Component 1	2
(a) Two components		
Complexity 1	0.579	0.705
Complexity 2	0.838	0.182
Complexity 3	0.628	−0.692
Complexity 5	0.916	−0.138
IT Infrastructure 2	0.783	−0.497
IT Infrastructure 3	0.819	−0.444
IT Infrastructure 4	0.710	0.544
IT Infrastructure 5	0.468	0.783
Return On Investment 2	0.792	0.140
Return On Investment 3	0.788	−0.503
Return On Investment 4	0.926	−0.267
Return On Investment 5	0.514	0.500
Return On Investment 6	0.379	0.728
(b) One Component		
Complexity 2	0.808	
Complexity 3	0.757	
Complexity 5	0.918	
IT Infrastructure 2	0.883	
IT Infrastructure 3	0.905	
IT Infrastructure 4	0.553	
Return On Investment 2	0.771	
Return On Investment 3	0.827	
Return On Investment 4	0.952	
Return On Investment 5	0.489	

Table VIII. Factor loading for complexity, ROI and IT infrastructure before and after dropping problematic items

tasks (Tjan, 2001; Liang *et al.*, 2007). Adding innovation factors of DOI in the investigation of the fitness dimension of cloud computing adoption will therefore provide a more encompassing and relevant assessment for public sector organizations to decide to adopt cloud computing based on their context.

7. Conclusion

Cloud computing has unique features such as measured services, elasticity and resource polling, making it an ideal solution for many developing countries' challenges such as cost, lack of compatibility and lack of IT skills. However, many factors may influence the public organizations' decision to adopt this new technology to implement e-services. This paper proposed a theoretical model to explore the influencing factors. Further, an instrument to measure the effect of these factors on making the decision to adopt the cloud computing was developed. To ensure the reliability and validity of the instrument, the development process passed through several stages. First, the measurements were developed based on the literature of the proposed model constructs and the cloud computing previous studies. Second, five academic staff and information system researchers evaluated the content validity of the instrument. The measurements were modified based on feedback from these experts. Third, five experts from the field (IT staff in public sector organizations) were engaged and asked to comment on the relevance and clarity of the items. Fourth, a pilot study was conducted by collecting real data from 26 respondents. The data were analyzed and some items were dropped to increase the reliability of the related scales to reach the accepted level. Further, factor analysis was carried out to assure the content validity of the scales measures. The developed instrument can be used to examine the effect of proposed factors on the governmental agencies' decision to use cloud computing to provide e-government services.

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Appendix. The instrument items

Task

- E-government ensures providing effective services to citizens.
- E-government enhances the organization internal operations' performance.
- E-government helps exchanging and sharing information between organizations effectively.

Relative advantage

- Providing e-services over the cloud will lower the costs.
- Using cloud computing will make it easier for organizations to implement e-government services.
- Cloud computing allows using the latest version of the technology.
- Using cloud computing would improve the quality of work organizations perform.
- Overall, using cloud computing would be advantageous for e-government implementation.

Complexity

- It is easy to get cloud computing services to do what organization official wants them to do.
- Interacting with the cloud computing services is not clear and difficult to understand.
- Learning to operate on cloud computing services cannot be easy for employees.
- It takes too much time for IT staff if they want to use cloud computing to do their normal duties.
- Overall, cloud services are easy to use.

Compatibility

- Using cloud computing fits well with the way organization usually performs.
- Cloud can easily be integrated into existing IT infrastructure.
- Cloud computing is compatible with the systems that are already in use.
- Using cloud computing services does not require many technical changes.
- Using cloud computing services is compatible with all aspects of organization work.

Trialability

- Before deciding to use any of cloud computing services, it can be tested properly.
- It is essential to be able to try out cloud services properly before deciding whether it fits with the organization's tasks or not.
- It is essential to be able to try cloud services (on a trial basis) long enough to see what they can do.
- Cloud computing is available to adequately test and run various e-government services.

Security

- Cloud computing provide sufficient security controls.
- The security systems built into the cloud computing services are strong enough to protect organization data.
- Cloud providers maintain the privacy and confidentiality of organization data.
- Cloud providers' servers and data centers are secure.
- Overall, cloud computing technology is more secure than traditional computing methods.

Fit

- Organization's computing task requirements to implement e-government services closely align with cloud services.
- Cloud computing will satisfy organization's computing needs to implement e-government services.
- Current e-government applications can be easily adapted to the cloud.
- It seems to be that cloud computing fit with organization requirements to provide e-government services.

Top management support

- Top management is interested in the use of cloud computing technologies in our operations.
- The organization's top management provides strong leadership and engages in the process when it comes to information systems.
- Top management encourages using new emerging technology to provide e-services.
- Top management understands the benefits of cloud computing technology.
- The top management supports the implementation of e-service using cloud computing.

Cloud knowledge

- Employees have basic knowledge about cloud computing.
- IT staff have good knowledge about the underlying structure of cloud computing.
- IT staff have good knowledge about the benefits of using cloud computing
- IT staff have good knowledge about various of cloud computing models (SaaS, PaaS and IaaS) and types (public, private, community and hybrid).
- Overall, IT staff have good knowledge about cloud computing.

ROI

- Cloud computing decreases the investment in new infrastructure.
- Deployment process of cloud computing involves a negligible amount of time and effort.
- Cloud computing decreases the cost of system maintenance.
- Cloud computing eliminates hiring expensive IT expertise in-house.
- Employees can use cloud computing to perform their work better with no need of more training.
- The benefits of cloud computing are greater than the costs of its adoption.

Asset specificity

- Special hardware/software is needed for using cloud computing.
- Employees with special expertise need to be hired to adopt cloud computing.
- To process organization data, cloud services providers would have to make substantial investments in equipment and software tailored to organization's needs.
- The use of cloud technology reduces the need for physical asset on-hand.

Uncertainty

- Cloud computing services might not perform well and create problems with our IT operations.
- Cloud computing services' servers may not perform well and may not support our IT operations effectively.
- The pay-as-use model of payment is not clear and makes it difficult to justify cost and benefits.

IT infrastructure

- The organization has the necessary technical requirements for using cloud computing systems.
- The organization has good internet connection speed.
- The organization is mature in using the internet and related technology.
- The organization needs to improve its computational capabilities.
- The organization needs cloud computing technology to meet its IT needs.

IT skills

- Within this organization, managers at all levels are IT literate.
- This organization has high levels of IT-related skills and technical knowledge.
- IS department know the business process well enough to identify the required applications.
- IS staff has the ability in supporting cloud computing system development.
- Within the organization, there are the necessary skills to using cloud computing services.

IT policies

- There is a lack of security rules, policies and privacy laws.
- Because of differences in legislation, organizations might lose control of data if cloud computing services provided by a supplier hosting data outside the country are used.
- There is no legal protection in the use of cloud computing.
- The laws and regulations that exist nowadays are sufficient to protect the use of cloud computing.

Viability

- The organization's capabilities and current resources support cloud computing.
- The organization can efficiently move computing needs to cloud computing.
- Cloud computing is viable to implement e-government services in the organization.

Cloud computing adoption

- It is recommended to use cloud computing approaches in the organization.
- It is anticipated that the organization will adopt cloud computing in the near future.
- The organization plans to evaluate and adopt cloud computing.
- The organization is currently engaged at the initial stage of cloud computing adoption.

Corresponding author
Fathey Mohammed can be contacted at: alqadsi_ye@yahoo.com