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Predicting motivators of cloud computing adoption: A developing country perspective

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ABSTRACT

Cloud computing is a recent and significant development in the domain of network applications with a new information technology perspective. This study attempts to develop a hybrid model to predict motivators influencing the adoption of cloud computing services by information technology (IT) professionals. The research proposes a new model by extending the Technology Acceptance Model (TAM) with three external constructs namely computer self-efficacy, trust, and job opportunity. One of the main contributions of this research is the introduction of a new construct, Job Opportunity (JO), for the first time in a technology adoption study. Data were collected from 101 IT professional and analyzed using multiple linear regression (MLR) and neural network (NN) modeling. Based on the RMSE values from the results of these models NN models were found to outperform the MLR model. The results obtained from MLR showed that computer self-efficacy, perceived usefulness, trust, perceived ease of use, and job opportunity. However, the NN models result showed that the best predictor of cloud computing adoption are job opportunity, trust, perceived usefulness, self-efficacy, and perceived ease of use. The findings of this study confirm the need to extend the fundamental TAM when studying a recent technology like cloud computing. This study will provide insights to IT service providers, government agencies, academicians, researchers and IT professionals.

1. Introduction

The emergence of web 2.0 has initiated a new era of collaboration, sharing, and social networking (Lytras, Damiani, & de Pablos, 2008). One of the most popular technologies in web 2.0, Cloud Computing (CC) systems provide on-demand network-based access to subscribers for the metered usage of an easily accessible and secure collection of remotely available information technology (IT) enabled resources and capabilities including network, servers, storage, applications and services (Armbrust et al., 2009). Further, Cloud Computing (CC) is defined by Subashini and Kavitha (2011) as "a way to increase the capacity or add capabilities dynamically without investing in new infrastructure, training new personnel, or licensing new software". These services include IT infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) on a pay-for-use basis (Rayport & Heyward, 2009). This computing paradigm seeks to deliver computing services similar to utility services such as water, electricity and gas (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). The limitless flexibility, better reliability and security provided by CC enables organizations customize services and data for higher availability without much worry (AMD, 2011). The emergence of cloud computing creates a level playing field for many firms by providing opportunities for utilizing cutting edge information technologies that hitherto were not affordable owing to the high cost of owning these technologies (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011). The synergy from the integration of big data technologies and cloud computing constitutes the basis for future computing (Agrawal, Das, & El Abbadi, 2011).

Cloud computing being a relatively recent phenomenon, the research on issues concerning the adoption of cloud computing by both organizations and individuals is still in a nascent stage. Among the research studies on the adoption of CC technologies conducted so far, quite a few have approached the problem from the perspective of organizations and not from individual user's

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perspective (Low, Chen, & Wu, 2011; Morgan & Conboy, 2013; Tashkandi & Al-Jabri, 2015). This research gap in extant CC literature requires considerable attention since individuals' varying perceptions and levels of readiness to adopt CC can be a major determinant of the degree to which the benefits are realized. Partly, the degree of adoption may be attributed to the concerns associated with CC; for example, data security, confidentiality, latency, performance instability and lack of service level agreements (Marston et al., 2011). The majority of adoption studies uses TAM and applies causal-explanatory statistical analysis for understanding relationships (Behrend, Wiebe, London, & Johnson, 2011; Lian, Yen, & Wang, 2014; Oliveira, Thomas, & Espadanal, 2014; Park & Ryoo, 2013; Yang & Lin, 2015). The problems using this approach are two-fold. Firstly, original TAM by Davis (1989) applies only two constructs perceived usefulness and perceived ease of use, which have their own limitations in explaining the intention to use (Venkatesh, Morris, Davis, & Davis, 2003); therefore, a number of researchers have pointed out the need to extend TAM by augmenting the original TAM with additional variables for better modeling of the intention to use. Next, information systems researchers have often highlighted the importance of predictive analytics instead of causal-explanatory statistical analysis that enables enhanced theory building and testing (Chong, 2013a; Shmueli & Koppius, 2010; Sharma, Joshi, & Sharma, 2016).

From the viewpoint of the individual user, the adoption of CC by individuals can be viewed from two perspectives, personal (Park & Ryoo, 2013; Yang & Lin, 2015) and professional. The adoption of a CC from a professional user or employee perspective, has rarely been conducted. Therefore, in this paper we focus on the determinants of individuals' adoption of cloud computing (CC) services in a professional setting for meeting job goals and requirements. This study is more important since the objectives for investing in cloud computing by firms are likely to be met if employees are willing and enthusiastic to adopt cloud computing on their job. Finally, studies on cloud computing adoption have been conducted in developed or large economies like Taiwan (Lian et al., 2014; Low et al., 2011), Portugal (Oliveira et al., 2014), India (Gangwar, Date, & Ramaswamy, 2015) and USA (Behrend et al., 2011). To the best of our knowledge, no study has been conducted in Middle Eastern countries, which is a significant economic block and includes number of emerging economies and oil rich countries. In a number of these countries, cloud computing has been introduced much later compared to developed countries. In Oman, a prominent country in the GCC in Middle East, Cloud Computing services were launched in 2012. This study seeks to bridge the research gaps by developing a research model that provides useful insights into the adoption of CC by Omani IT professionals (individual users) in a professional or work setting using causal explanatory and predictive analytical modeling.

With all the publicity surrounding Cloud computing, the global public sector has embraced this technology much slower than the private sector. Where private sector has been willing to invest in and deploy cloud computing, the public sector still remains in an investigative stage (Kundra, 2010). Government entities can often face many hurdles such as the lack of in-house expertise; lack of trust in the technology; absence of a regulatory authority and most importantly the lack of will (Mell & Grance, 2009; Yoo, 2011). As the public sector companies in Oman transition to cloud computing environments, it becomes important to understand factors that would promote organization wide adoption of cloud computing technologies. To the best of authors' knowledge, a study seeking to understand employees' perception of cloud computing technologies in organizations has not been conducted in any country. Only one study focusing on adoption of SaaS by organizational users has been recently published (Yang, Sun, Zhang, & Wang, 2015). Thus, this research study fills an important research gap by identifying the key factors that influence the adoption of Cloud computing by employees in public sector organizations in Oman. A quantitative survey was carried out among information technology personnel in Oman. The findings from this study provide the much needed research support for ongoing cloud computing implementations in findings for Oman and other emerging economies in the GCC. The research model and hypotheses employ two types of factors, namely, human-related factors (computer self-efficacy, job opportunity) and system-related factors (Perceived Usefulness, Perceived Ease of use and Trust) to determine any significant impact on the IT personnel's willingness for adoption of Cloud Computing.

The remainder of the paper is structured as follows. A review of the pertinent literature is presented in Section 2. The research design that was used to test our research model is presented in Section 3. Finally, we present the results of our analysis with key conclusions in Sections 4 and 5.

2. Literature review and hypotheses development

The majority of the studies conducted in the literature of cloud computing adoption investigated the determinants of adoption of cloud computing by organization. Low et al. (2011), Morgan and Conboy (2013) and Lian et al. (2014) employed the Technology-Organization-Environment model to study the factors affecting the adoption of cloud computing in organizations such as high technology firms and hospitals. However, the adoption of a new technology by the organization can fail if the individual users within the organization are slow in adopting the new technology. Therefore, several research studies to understand the behavioral constructs influencing individual user adoption of a technology have been reported in the information systems literature (Al-Somali, Gholami, & Clegg, 2009; Davis, 1989; Sharma & Govindaluri, 2014; Venkatesh et al., 2003). The earliest studies in this regard developed models explaining the factors influencing “intention to use” the technology using three theories, Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), Theory of Planned Behavior (TPB) (Ajzen & Fishbein, 1980) and Technology Acceptance Model (TAM) (Davis, 1989). Intention is considered a direct determinant of behavior in the TRA that is influenced by the attitude (attitude toward performing behavior), and subjective norms (social pressures to perform behavior). TRA and its extension, the theory of planned behavior (TPB) (Ajzen & Fishbein, 1980) have been tested and used extensively.

TAM was originally proposed by Davis (1989) for explaining the link between the actual use of the new technology and the behavioral intention (BI) of the individual to use the technology and is partly based on TRA. TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) are the fundamental determinants of the attitude towards the acceptance of new technology. Davis (1989) defines PU as “the degree to which a person believes that his/her job performance would be enhanced by using a particular technology” and PEOU as “the degree to which a person believes that using the technology requires less mental efforts”. TAM has been employed to investigate the adoption of new technologies in a range of domains including e-learning (Singh & Hardaker, 2014), internet banking (Sharma, Govindaluri, & AlBalushi, 2015), mobile learning (Tan, Ooi, Sim, & Phusavat, 2012), and social networking (Shin, 2010; Sharma et al., 2016). With regard to cloud computing, some studies can be found in the literature that employ TAM to model the technology acceptance by

individual users for personal purposes. For example, Behrend et al. (2011) proposed an extension of TAM to identify factors determining successful acceptance of a cloud computing initiative in a community college. Another study on the adoption of cloud computing services by undergraduate students in a university setting was conducted by Park and Kim (2014). In both cases, Behrend et al. (2011) and Park and Kim (2014), the studies were conducted in developed countries. Next we discuss the various factors that might influence the user's acceptance of cloud computing in a work environment along with the corresponding hypotheses for our research study conducted in a developing country.

2.1. Perceived usefulness

The definition of perceived usefulness (PU) originally proposed by Davis (1989) was refined by Kim, Chan, and Gupta (2007) as "the total value a user perceives from using a new technology". The perceived usefulness can be a function of the learning value in terms of upgradation of technological knowledge of the user owing to the adoption of the new technology. Jeyaraj, Rottman, and Lacity (2006) observed in their meta-analysis research based on the acceptance of information systems that PU is one of the most significant factor in the majority of adoption studies. Sánchez and Hueros (2010), Chong (2013a), and Sharma et al. (2015) support the hypothesis that PU plays a significant role in the adoption of internet related services. In case of smartphones adoption, perceived usefulness is viewed as the increased convenience and ability to accomplish daily tasks and was found to be an important determinant of smartphone adoption (Joo & Sang, 2013). Similar conclusions with regard to PU resulted from studies dealing with acceptance of information systems including wireless Internet, Intranet, and mobile information systems (Gao, Krogstie, & Siau, 2014; Horton, Buck, Waterson, & Clegg, 2001; Lu, Yu, Liu, & Yao, 2003). Park and Kim (2014) conducted a study on mobile cloud services and their investigation seeks to explain the relationship between adoption and job performance improvement. PU was found to be influencing the job performance of individual users. Cloud computing is known to be useful in several ways; the user is not restricted by location, offers multiple opportunities to learn new softwares and access a range of hardware and software resources that are not owned internally by the company. All these advantages enable the user significantly to learn and improve job performance. Therefore, it would be worthwhile to explore if these benefits influence the perceived usefulness and subsequently the cloud computing adoption decision.

H1. Perceived usefulness has a positive and significant relationship with individuals decision to adopt cloud computing services.

2.2. Perceived ease of use

Similar to perceived usefulness, perceived ease of use (PEOU) is an integral component of TAM. PEOU may differ depending on the varying degree of expertise in interacting with and utilizing cloud computing services. Whereas users may be become familiar with various internet services and find them easy to use in a shorter time period, the same need not be true in case of cloud computing services. A number of studies in the information systems adoption literature including new technologies discuss the influence of PEOU on their acceptance; for example, mobile internet (Kim et al., 2007), internet banking (Sharma & Govindaluri, 2014) and smartphone technologies (Kim & Sundar, 2014). All the aforementioned studies show that ease of use plays an important role in the acceptance of a relatively new information technology. On the contrary, literature also contains studies that have not found PEOU to be a significant factor. In this regard, the study by Chong (2013b) in the context of mobile commerce adoption in China is a good example. The study by Chong (2013b) used advanced hybrid statistical modeling and found that ease of use was not a statistical significant predictor. Few studies have observed that perceived ease of use is as good as perceived usefulness (Al-Somali et al., 2009; Sharma & Govindaluri, 2014). Lu et al. (2003), Horton et al. (2001), and Gao et al. (2014) have suggested perceived ease of use is an important determinant of acceptance of information systems such as wireless Internet, Intranet, mobile information systems respectively. Cloud computing services are relatively new to Omani users; therefore, it is important to explore whether Omani users perceive cloud computing services easy or difficult. Hence we propose the following hypothesis:

H2. Perceived ease of use has a positive and significant relationship with individual's decision to adopt cloud computing services.

2.3. Computer self-efficacy

Bandura (1982) proposed the definition of self-efficacy as "the extent or strength of one's belief in one's own ability to complete a task". Computer self-efficacy has been observed as an important factor influencing users' decision to adopt computer related technology (Sharma & Govindaluri, 2014). Self-efficacy seeks to measure the confidence that an individual possesses in performing the requisite tasks using the technology Sánchez and Hueros (2010). This was defined by Sánchez and Hueros (2010) in the context of computer systems and refers to the level of confidence exhibited by IT professionals in their ability to use computer systems. The concept of self efficacy has been discussed by Rowley (2006) and Udo, Bagchi, and Kirs (2012) in connection with increasing the customer's knowledge and skill sets associated with a service process and proposed as a key organizational strategy for managing customer satisfaction. Research has pointed out the need to elevate e-service encounter by incorporating enhanced user learning through use of e-services rather than solely focusing on the superior web site design and unambiguous navigation instructions (Udo et al., 2012). An individual having higher degree of computer self-efficacy is expected to feel more comfortable in learning new knowledge from the use of internet related activities. Cloud computing services are relatively new phenomena in the domain of internet related activities and involved various computing devices. Based on the support from the information systems literature, it can be observed that the higher computer self-efficacy leads to achieve desired results. It is therefore worthwhile to propose the following hypothesis:

H3. Computer self-efficacy has a positive and significant relationship with the individuals decision to adopt cloud computing services.

2.4. Trust

Trust has three components namely ability, integrity, and benevolence (McKnight, Choudhury, & Kacmar, 2002). In the context of cloud computing, ability refers to the possession of requisite skills and resources for meeting needs of organizational (client's end) users. Integrity refers to the commitment level of the cloud computing vendor to honor obligations to the best of their abilities and benevolence is the assurance that cloud computing vendors have the best interests in their mind with regard to the

customer. Trust is an important factor affecting adoption of new technology. As cloud computing services are relatively new concept among Internet services, integrity aspects of this technology needs to be explored. In cloud computing services, users are often required to share critical information online. It is important for cloud computing industry to ensure adequate privacy and security for sensitive information of users (King & Raja, 2012). In cloud computing services the transmission of data in a wireless environment exposes the sensitive information of the user to risk. Svantesson and Clarke (2010) suggested that cloud computing services providers establish the policy which permits users to ensure that their sensitive data are in safe hands. Furthermore, these two researchers studied privacy policy of Google comprehensively and found that users have very limited understanding of how users' personal information may be used by Google. It is quite understandable that complete elimination of risk is almost not possible, it is therefore worthwhile to explore the influence of trust issues in the context of a developing country like Oman. We propose the following hypothesis:

H4. Trust has a positive and significant relationship with individual's decision to adopt cloud computing services.

2.5. Job opportunity

Job opportunity is defined as the user's perception of the degree to which the use of new technology generates higher future employability for the user. This implies, the new skill sets acquired by the user subsequent to the use of technology improve his/her attractiveness in the job market and the potential to earn a superior job. Job attributes and their influence on adoption have been included in prior studies. For example, job relevance (Venkatesh & Davis, 2000), involvement (Hartwick & Barki, 1994), task-technology fit (Goodhue & Thompson, 1995) and task significance (Hackman & Oldham, 1980). These factors refer to the importance of the technology on individual's current job accomplishment. However, individuals are often motivated to adopt new technologies in the drive to improve their performance not only on the current job but to enhance their skill set that provides them greater overall employability in the job market. Thus, if a new technology/system offers more job opportunities, it may increase the chances of its adoption by individuals. This may be more apt in case of cloud computing in general and a GCC country like Oman in particular, since it is a newer technology and firms prefer to hire employees having exposure and experience in using cloud computing environments. Oman is poised to embrace cloud computing on a large scale to maintain its rapid pace of technological development in multiple sectors (Oman Observer, 2015). This may result in large number of job openings in cloud computing, an area in which Oman has limited skilled knowledge workers. Therefore, the desire to build skills in cloud computing for improving job opportunity can play a significant role in the Omani IT professional's adoption decision. Thus, we intend to explore the impact of higher job opportunity on the decision to adopt cloud computing services. Hence, we propose the following research hypothesis:

H5. Job opportunity has a positive and significant relationship with individual's decision to adopt cloud computing services.

3. Research methodology

The methodology in this paper is similar to the approach adopted by Chong (2013a) and Sharma et al. (2015). This research employs neural network model as the primary tool for analysis and compares the results obtained with respect to prediction of adoption of cloud computing by neural network model with those obtained by the MLR model.

3.1. Sampling and data collection

A survey questionnaire was developed to explore the various determinants affecting the adoption of cloud computing with the help of free online service provided by Google. The survey was primarily developed in English language and translated into Arabic language by a language instructor to maintain consistency. The survey was designed with the consultation of a focus group discussion of 5 experts of information systems. A pilot study was conducted and the survey was modified based on the results of it. The first question in the survey was whether respondent has used cloud computing services in Oman. Since cloud computing is a relatively new phenomenon in Oman, it was relatively difficult to get sufficient sample size for the study because there are limited IT personnel using cloud computing for various purposes. Therefore, convenient sampling procedure was adopted to distribute survey. A web page link of survey was sent to respondents. The information related to the demographic profile of respondents are provided in Table 1. The data were collected in the months from March to May 2015. One hundred and one usable responses were obtained from cloud computing users. The minimum sample size of 10 samples for each independent variable was achieved as recommended by Hair, Black, Babin, and Anderson (2010).

3.2. Variables and measurements

This study attempts to understand and predict the key determinants affecting the slow adoption of cloud computing on the basis of IT professionals' perception in Oman. These determinants adapted from the literature including, perceived ease of use (Al-Somali et al., 2009; Davis, 1989; Sharma & Govindaluri, 2014), perceived usefulness (Al-Somali et al., 2009; Davis, 1989; Sharma & Govindaluri, 2014), self-efficacy (Al-Somali et al., 2009; Sharma & Govindaluri, 2014), trust (Al-Somali et al., 2009; Riffai, Grant, & Edgar, 2012) in the context of cloud computing adoption. A new variable is proposed in this study namely job opportunity. This variable was developed in the consultation with information systems experts. All determinants other than four demographic variables were measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). For measurement purposes, a total of 14 indicators were used for independent variables and 3 indicators in case of the dependent variable *Will* of cloud computing (Sharma & Govindaluri, 2014). All measurement scale indicators and its descriptive statistics is made available in appendix. Descriptive statistics should be computed to confirm univariate normality of data (Hair et al., 2010). In other words, if the data are not following univariate normal distribution then it may affect final results. The mean values of all 14 items ranged from 2.97 to 4.11 on the Likert scale of 5 and the standard deviations ranged from 0.747 to 1.054. The skewness indicates the symmetry of distribution and kurtosis indicates the peak of the distribution (Pallant, 2010). As per the recommendations of Tabachnick and Fidell (2007) the normal ranges for skewness and kurtosis is ±2.58. The skewness and kurtosis indices of our data varies from −0.898 to −0.138 and −0.906 to 0.824 respectively. Therefore the data in this research were considered univariate normal.

3.3. Profile of respondents

Table 1
Demographic profile of respondents.

Variables		Frequency	Percentage
Gender	Male	69	68.3
	Female	32	31.7
Age	Less than 30 years	23	22.8
	31–40 years	50	49.5
	More than 40 years	28	27.7
Education level	Diploma	20	19.8
	Bachelor	44	43.6
	Masters/higher	37	36.6
Cloud Computing usage	Infrastructure as a service	40	39.6
	Platform as a service	21	20.8
	Software as a service	40	39.6

3.4. Scale reliability and principal components analysis

The reliability of constructs was measured by the Cronbach alpha as suggested in Hair et al. (2010). The values of Cronbach alpha for all constructs are summarized in Table 2. The Cronbach alpha for all determinants was above 0.75 in line with the recommendations made in Hair et al. (2010). As recommended by Chong (2013a) principal components analysis was technique used to identify underlying dimensions that explain the correlations among a set of variables. Further, the principal components analysis was used to explain indicators' validity along with the grouping of indicators into useful factors. Principal components analysis may be commonly used when the primary objective is to obtain the minimum number of factors that will account for maximum variance in the data. The orthogonal varimax rotation was used in order to optimize the number of variables with higher loadings on a particular factor, which helps in the interpretation of the factor. The factors obtained with the help of orthogonal rotation are uncorrelated and this method of rotation is useful in the generalization of research findings. A construct is considered valid if the factor loadings of each factor was higher than 0.5 (Hair et al., 2010). A total number of five useful factors were extracted when a principal component analysis was performed on 14 indicators. The total variance explained was 76.866 percent. The communalities of each measurement item were greater than 0.5 and meet the guidelines for recommended communalities by Hair et al. (2010). The values of communalities are included in the Appendix at the end of the paper. The important results obtained from principal components analysis are summarized in Table 2.

3.5. Multiple linear regression analysis

The research framework proposed in this study was tested using multiple linear regression (MLR) model to understand the relationship between independent variables that predict the adoption of cloud computing services. Multiple linear regression (MLR) analysis is used to perform the modeling of the linear relationships between a dependent variable, *Will* with respect to five independent variables considered in this study (Hair et al., 2010). The variable *Will* measures the degree to which users adopt cloud computing and is a combination of acceptance and usage of the cloud computing in a developing country like Oman in GCC. MLR results showed a relatively low value of coefficient determination ($R^2 = 0.58$). Since the R^2 value is relatively low showing the weakness of linear model in explaining the variance, a non-linear model may be considered (Sharma et al., 2015). Hence a neural network model, which is non-linear in nature was selected to model the relationship between *Will* of cloud computing and the independent variables. The results obtained from regression model are compared with the results of the neural network model in the next section. The summary of MLR results is given in Table 3. The results obtained from MLR are statistically significant at 1% level of significance; this shows that *self-efficacy* (beta value = 0.489) is the most important predictor of the adoption of cloud computing, followed by *PU* (beta value = 0.377), Trust (beta value = 0.305), *PEOU* (beta value = 0.233), and *JO* (beta value = 0.219).

3.6. Neural network results

Artificial neural network is widely used artificial intelligence approach for modeling complex relationships between a set of variables. These resemble the structure of constituent units in the human brain consisting of the neuron, synapse and the axon. Further, similar to the neural networks in human brain these networks have the ability to gain knowledge through learning procedures. ANN is defined by Haykin (2007) as "a massively parallel distributed processor made up of simple processing units, which have a natural propensity for storing experimental knowledge and making it available for use". Neural networks, particularly the multilayer perceptron type, have the ability to capture non linearity and to learn by constructing input-output mapping (Sim, Tan, Wong, Ooi, & Hew, 2014).

The neural network model for our research study was developed using SPSS 23.0 software. The training of neural network model was performed using the multilayer perceptron training algorithm. Neural networks models are prone to overfitting and hence cross validation was performed. The accuracy of the network model is measured by the Root Mean Square Error (RMSE). Activation function in hidden layer used in this study was a hyperbolic tangent (Sharma et al., 2015). Furthermore, Wang and Elhag (2007) and Sharma et al. (2015) suggested examining neural network model by varying the number of hidden nodes from one to ten. The number

Table 3
Regression results.

Model	Beta values	t-values	Significance
Job Opportunity	0.219	3.285	0.001
Self-Efficacy	0.489	7.333	0.000
Perceived Usefulness	0.377	5.644	0.000
Perceived Ease of Use	0.233	3.484	0.001
Trust	0.305	4.572	0.000

Table 2
Results of reliability and principal components analysis.

Constructs	Items	Factor loadings range	Eigen values	% of variance	Cronbach alpha
SE	3	0.791–0.886	2.434	16.230	0.862
Trust	2	0.842–0.852	1.688	11.252	0.755
PEOU	3	0.796–0.851	2.311	15.404	0.820
JO	3	0.704–0.805	2.578	17.249	0.807
PU	3	0.774–0.853	2.323	15.488	0.833

SE: Self-efficacy; PEOU: Perceived ease of use; PU: Perceived usefulness; JO: Job opportunity.

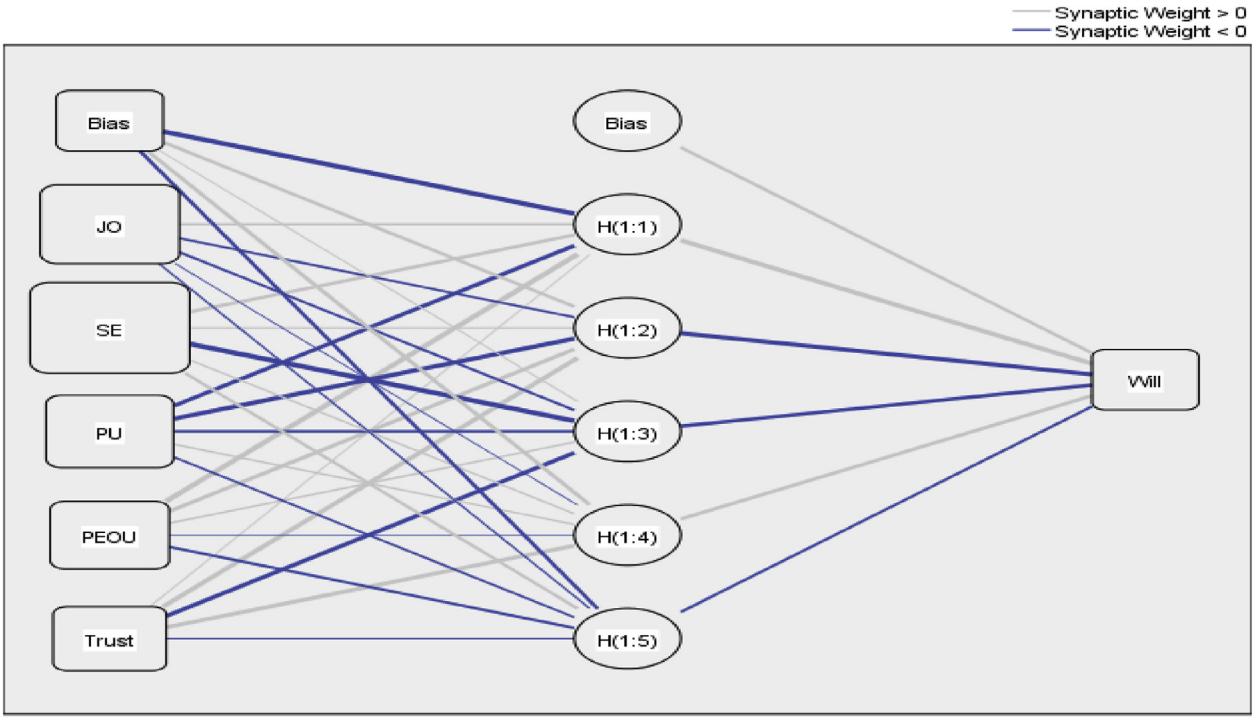
of nodes was varied since algorithms for determining the exact number of hidden nodes in a neural network model are not available. In this study, 10-fold cross validations were used where seventy percent of the data points were used to train network model and thirty percent data points were used to test the model. Five variables namely *perceived usefulness*, *perceived ease of use*, *trust*, *self efficacy* and *job opportunity* were included in input layer of the network model. The dependent variable *Will* of cloud computing was included in the output layer of the network model. The comparison of RMSE values reflects the superior performance of the neural network model over the regression model. These results are presented in Table 4. The RMSE value for training model was 0.288 and that of the testing model was 0.397 whereas RMSE of regression model was 0.667.

Thus, the neural network model achieves a better for of the model and also captures non-linear relationship of independent variables with respect to the dependent variable *Will* in the context of cloud computing adoption.

Table 4
RMSE for neural network model.

Network	Training	Testing
ANN1	0.289	0.393
ANN2	0.291	0.352
ANN3	0.324	0.391
ANN4	0.223	0.419
ANN5	0.312	0.401
ANN6	0.292	0.415
ANN7	0.296	0.411
ANN8	0.317	0.397
ANN9	0.298	0.384
ANN10	0.238	0.407
Mean	0.288	0.397
Standard deviation	0.033	0.019

independent variables and the dependent variable in order to predict the willingness to adopt cloud computing services by



In order to understand the relative importance of independent variables to predict adoption of cloud computing, a sensitivity analysis was performed in the neural network model. The summary of the normalized importance of independent variables is given in Table 5. The importance of an independent variable is a measure of the degree to which the network's model-predicted changes in the output values with respect to the changes in values of independent variables (Chong, 2013b). On the basis of the neural network results, the most important independent variable in predicting *Will* of cloud computing were Job Opportunity (*JO*), followed by *Trust*, *perceived usefulness*, *self efficacy* and *perceived ease of use.*

4. Discussion

This study captures causal relationship between the employing a hybrid approach of linear and nonlinear modeling. The proposed hybrid approach improves the predictive ability of the model. The multiple linear regression (MLR) model results showed that self-efficacy, perceived usefulness, trust, perceived ease of use, and job opportunity contribute significantly towards willingness to adopt cloud computing services by IT professionals in Oman.

Table 5
Sensitivity analysis.

Variables	Importance	Normalized importance
Trust	0.218	80.3%
Job Opportunity (JO)	0.272	100.0%
Perceived Usefulness (PU)	0.190	69.9%
Self-efficacy (SE)	0.168	61.8%
Perceived ease of use (PEOU)	0.152	56.0%

According to MLR results, self-efficacy emerged as one of the strongest determinant which affects adoption of cloud computing by IT professionals in Oman. Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action to require to attain designated types of performance" (Bandura, 1997). Cloud computing is a complex system and a higher perceived ability or mastery in effectively utilizing such systems exerts a positive influence on the self-motivation and persistence to adopt new technologies. Yang and Lin (2015) showed that cloud service self-efficacy was a key determinant in the continuance usage of cloud computing services. The results obtained in this study are parallel to the study conducted by Yang and Lin (2015). Perceived usefulness is the second most important determinant influencing the adoption of cloud computing services. Cloud computing provides access to a variety of IT enabled tools that can have positive impact on job performance and hence the perceived usefulness. This result is in line with other studies conducted in information systems research (Al-Somali et al., 2009; Sharma & Govindaluri, 2014). The cloud computing services offers several advantages to IT professionals that can enhance their overall capabilities owing to easy access to several expensive information technology enabled resources which would otherwise be not affordable in a traditional computing environment. Consequently this can result in improved flexibility and efficiency leading to higher overall performance on the job. The superior benefits and inherent characteristics associated with perceived usefulness made cloud computing services more influential determinant than perceived ease of use and trust. Hence, service providers need to focus on designing cloud computing solutions that meet IT professionals' requirements for improving their productivity and performance.

This study validates the prior studies that trust is also an important determinant in the adoption of cloud computing services (Al-Somali et al., 2009; Sharma & Govindaluri, 2014). In comparison to other IT/IS services, cloud computing services are relatively new IT services and still at the stage of infancy in several developing countries. Unlike traditional computing where the user has a rough idea regarding the location of data with the company internal network, cloud computing is characterized by location uncertainty contributed by the variable and flexible allocation of storage and processing resources. Though, this uncertainty can be lower in case of a private cloud. At the same time, the protocol employed to communicate with the back end can introduce multiple risks depending on the nature and intricacies of the interface. Therefore, the degree of trust in cloud computing services is required to be addressed by service providers in order for the customers to feel comfortable to hand over data to an external large cloud computing network. The MLR results established perceived ease of use as another determinant influencing adoption of cloud computing services. This result conforms to several IT/IS studies such as Hsu, Shih, Huang, Lin, and Lin (2009), Lee and Wu (2011), Sharma and Govindaluri (2014). The ease of use of cloud computing services is crucial as this technology is relatively nascent in several developing countries. Once again, the middleware and front end play a major role in enhancing the ease of use.

Finally, job opportunity influences the adoption of cloud computing services by IT professionals. Many IT professionals feel that more opportunities would be generated in the latest technologies such as cloud computing and big data since the majority of traditional computing may migrate to newer platforms in the future. For example, several e-Government services are now transitioning or considering transitioning to cloud services. Also, the supply of professionals having expertise in cloud computing related technologies is in severe shortage. Therefore, IT professional are motivated to adopt cloud computing since it implies a higher employability value and greater job security on the current job.

To understand the prediction of cloud computing services adoption, this study employed neural network modeling. This neural network modeling have better predictive capability over several other traditional statistical techniques (Chong, 2013a; Shmueli & Koppius, 2010). The neural network model results showed job opportunity was the most important predictor of the adoption of cloud computing services and in line with the MLR results. It was followed by, trust, perceived usefulness, self-efficacy and perceived ease of use contradicts the findings of MLR results.

5. Implications

The results obtained from the proposed research model suggested some practical hints that self-efficacy is a statistically significant predictor of cloud computing services in Oman. The research outcomes suggest that job opportunity could influence the adoption of cloud computing services. Hence, organizations are suggested to create awareness about the future potential of these services in terms of their increased penetration in computing world and employability value. Adoption is sensitive to trust issues, when IT professional have limited clarity regarding network and software security, backup provisions and access related protections. Any uncertainty and risk associated with cloud computing services may prevent the adoption of this useful IT service. In order to increase the intention to adopt cloud computing services, decision makers are suggested to invest in technology and process which take up security and privacy issues to a new level of benchmark and also focus on both actual and perceived security. In terms of enhancing perceived usefulness, which is the next important predictor, organizations can demonstrate how cloud computing can enable improved performance. The increased performance can be owing to the flexible access to a range of IT enabled, both hardware and software.

Self-efficacy of users is about his/her capability to use cloud computing services. These capabilities also play a significant role in the continuous usage of the new technology. Users' expertise in cloud computing services improves the overall acceptance of the technologies in the organization and result in a higher return on investment. Hence, organizations are encouraged to provide training programs, workshops, seminars to their employees. Also, the findings suggest an increased focus on increasing ease of use by ensuring easy to use interface, greater visibility and user operating procedures. Ease of use can also be supported by means suggested to increase self-efficacy such as training, documentation and customer help facility.

This research has developed a hybrid model in the study of information systems acceptance by integrating MLR and neural network. The application of hybrid model in this research has addressed limitations of past adoption studies in the domain of information systems. The main advantage of this hybrid model is its accuracy in predicting determinants of a new information technology. MLR and neural network models have been applied separately in the studies related to information systems and there are very few studies have employed such hybrid model. MLR is employed to understand causal relationship in this study and neural network model to predict determinants of cloud computing services acceptance.

5.1. Economic implications

Higher willingness to use cloud computing on the job by employees is important for organizations to integrate cloud computing in their information technology toolkit. The pressure to adopt cloud computing is immense for Omani organizations in the current

environment. This study is conducted in Oman, one of the prominent developing countries in the Middle East. The recent decline in oil prices are adversely impacting the financial commitments relating to permanent ownership of computing infrastructure. Economically, lesser funding implies less capital to invest in dedicated computing facilities. Therefore, firms seeking to integrate latest technologies for optimizing operations and processes to effect higher efficiencies and cost reductions are likely to resort to cloud computing. Further, the recent drive by the Omani government to develop small and medium enterprises can benefit from cloud computing since these upcoming ventures with limited capital can have access to powerful information technologies and data from the cloud.

5.2. Organizational implications

Research studies on cloud computing adoption are almost nonexistent; therefore, the outcomes of this research study can provide the much needed research support to service providers in many Middle Eastern countries who are in the process of developing appropriate strategies to design and promote their services to organizational users. Well-designed services from CC service providers can improve employees' adoption of cloud computing that can have organizational implications. For example, the increased adoption of CC can result in growth of job opportunities, technological competence, technological flexibility and competitiveness. Cloud computing provides a leveled competitive playing field by providing utility computing access to cutting edge information resources.

5.3. Social implications

The main social impact of cloud computing is creation of numerous job opportunities for development, maintenance and security in the cloud infrastructure. Cloud computing substantially improves the processing speed necessary to manage the functionality of a range of applications including search engines and social networking among others. The adoption of cloud computing by governmental and not for profit organizations can strengthen the abilities to address social challenges facing emerging economies like Oman.

6. Limitations and future research

This study has some limitations. Since organizations in rural areas may not rely on the state-of-art information technologies, the study focused on collection of data from urban areas. Therefore, the generalization of the findings of this study to the whole country and other countries would require a larger sample. Future research work can be planned by collecting cross country data that involves a larger sample from the whole country and other Middle Eastern countries. We attempted to provide a comprehensive model in this research by incorporating important adoption determinants. Future research can be conducted by incorporating factors from other important adoption models such as Task Technology Fit model, UTAUT, TOE (Technical, Organizational, Environment) framework etc. This study focused on the adoption of cloud computing services from IT employee's perspectives. The investigation of continual intention to use this promising technology can be a potential future research topic.

7. Conclusion

The primary goal of this research was to develop and test and empirical model for understanding the impact of determinants, job opportunity, self-efficacy, perceived usefulness, trust and perceived ease of use on the willingness to adopt cloud computing services by organizational users. The proposed factors, namely, job opportunity, self-efficacy and trust were successfully integrated into the original TAM and the factors were found to be important in influencing the adoption of cloud computing services. Further, job opportunity, which was one of the proposed factors and an important contribution to the adoption factors collection, was found to be the most significant predictor of cloud computing services adoption. The researchers consider this study to be provide important inputs to other researchers interested in studying the adoption of cloud computing since number of studies in this area are limited.

Appendix

Descriptive statistics and communalities of measurement scale items

Indicators of each dimension	Mean	S.D.	Skewness	Kurtosis	Communalities
Perceived Ease of Use (PEOU)					
I think learning how to use Cloud Computing services is easy	3.90	0.770	−0.398	−0.076	0.753
Learning how to use Cloud Computing services requires less mental efforts.	3.70	0.965	−0.595	0.016	0.727
I think Cloud Computing services is easy	4.05	0.829	−0.523	−0.357	0.809
Perceived Usefulness (PU)					
I think Cloud Computing services improve my performance.	4.13	0.770	−0.494	−0.363	0.861
I think Cloud Computing service improve my productivity.	4.11	0.747	−0.327	−0.677	0.851
I think Cloud Computing services are useful for my overall work	3.98	0.860	−0.828	0.824	0.697
Self-efficacy (SE)					
I am confident in using Cloud Computing services.	3.90	1.054	−0.898	0.464	0.841
I have experience in using Cloud Computing services.	3.55	1.053	−0.644	0.181	0.766
I encourage organizations to adopt in Cloud Computing services.	3.91	0.918	−0.455	−0.625	0.775
Trust					
I am confident about the security available with Cloud Computing technology?	2.97	0.974	−0.138	−0.906	0.793
I am confident about the privacy and integrity of data made available through Cloud Computing?	3.25	0.942	−0.298	0.169	0.779
Job opportunity (JO)					
I think adopting Cloud Computing will create new job opportunities	3.85	0.994	−0.693	−0.216	0.669
Learning Cloud Computing will provide more job options to me in future	3.86	0.837	−0.671	0.683	0.706
Organizations adopting Cloud Computing will require more experts in future	3.68	1.009	−0.754	0.115	0.735
Willingness (Will)					
I am using Cloud Computing services	3.95	1.014	−0.898	0.280	0.779
I recommend the use of Cloud Computing services to peers	3.99	0.768	−0.388	−0.215	0.813
I will be using Cloud Computing services in future	4.15	0.805	−0.747	0.782	0.753

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