Factors Influence the Adoption of Cloud Computing: A Comprehensive Review

Hayder Salah Hashim[1,2,*]   Zainuddin Bin Hassan[2]   Ali Salah Hashim[1]

[1]Basrah University, Basrah-Iraq

[1,2]Universiti Tenaga Nasional, College of IT, Selangor-Malaysia

haydersalahm@gmail.com   zainuddin@uniten.edu.my

alishashim2009@gmail.com

ABSTRACT
Cloud computing is a new technology emerged during the recent years. Empirical and literature review studies mostly focused on business domain. The purpose of this paper is to review and identify the factors that influence the adoption of cloud computing. The study covered four main areas that namely business organizations, education, end users, and IT professional perspectives. A total of 81 articles were reviewed in these area, out of which 25 articles between 2010 to 2015 were selected and considered valid. A frequency analysis was conducted on the factors that have been used by the researchers. The findings showed that the most common factors were security and privacy followed by relative advantage, compatibility, complexity, ease of use, and usefulness. The cloud computing adoption studies were dominated by Technology Acceptance Model, followed by Technology-organization-environment, Diffusion of innovation, and Unified Theory of Acceptance and Use of Technology.

Keywords: Cloud computing adoption, Education, Business, IT professional, End user, TAM, DOI, UTAUT, TOE

1. INTRODUCTION
Cloud computing is a new technology that has officially emerged in 2007 (Nasir & Niazi, 2011). It enables convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell & Grance, 2011). It provides computing services such as hardware and software on demand regardless of the device or the location (Marston et al., 2011). The resources required to provide the requisite quality-of-service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction. Users pay for the service as an operating expense without incurring any significant initial capital expenditure (Marston et al., 2011).

Previous studies have investigated the technology in many areas. These included business organization (Gupta et al., 2013; Güner & Sneiders, 2014), users (Alotaibi, 2014; Shin, 2013; Shin, 2015), IT professional (Wu, 2010; Optiz et al., 2012; Phaphoom et al., 2015), and education (Gohary et al., 2013; Van Der Schyff & Krauss, 2014; Lim et al., 2015) among others.

Similarly, several theoretical models were used by researchers to facilitate the understanding of the factors that affect the move to the cloud and explain the variation in the adoption. Researcher have used Technology Acceptance Model (TAM) by Davis (1989), (Wu, 2010; Opitz et al., 2012; Shin, 2013; Burda & Teuteberg, 2014), Unified Theory of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003), (Cao et al. 2013; Lian, 2015), Diffusion of Innovation (DOI) by Rogers (1995) (Lin & Chen, 2012; Yang et al., 2012; Stieninger et al., 2014), Technology-organization-environment (TOE) by (Picoto et al., 2013; Borgman et al., 2013), Theory of planned behavior (TPB) by Ajzen (1991), (Arpaci, Kilicer & Bardakci, 2015), or mix between the theoretical models to come up with new models (Lian et al., 2014; Oliveria et al. 2014; Stieninger & Nedbal, 2014; Gangwar et al., 2015)

Previous studies have attempted to identify the factors that influence the adoption of cloud computing. Literature review studies were conducted mainly on business organizations (e.g. Alkhater et al., 2014). Our search was unsuccessful to find comprehensive review studies in cloud computing. In addition, there is no general agreement on the factors that influence the adoption of cloud computing whether in business organizations, or in other domains such as education, end users, and IT professional perspectives. Therefore, this study aims to review and integrate the literature to come up with a comprehensive view of the all factors that influence the adoption of cloud computing in these areas of the cloud adoption. The study also aims to identify the most common factors among these areas that the cloud is being adopted. Thus, the paper consists of five sections. The first section presented an introduction of the topic along with the issues, and the objectives of this paper. In the second section, the methodology of this paper was presented. Third section presents the literature review. In the fourth section, the findings of the study were presented and discussed with the literature. Lastly, the section concluded the study and provided direction for future work.

2. METHODOLOGY

This paper is a literature review study that attempted to identify the factors that influenced the adoption of cloud computing technology. The search engine was used to search for article in this domain. Key words such as cloud computing, factors, adoption, and a combination of these words were used to identify the related articles. A total of 81 studies were found investigating the cloud computing adoption and other topics in the cloud. A total of 51% from ISI journals, followed by 34% from Scopus and 15% conference proceeding. The articles were refined to find those that focus on the factors that influence the cloud computing adoption. A total of 25 articles were found in this regard. Other articles were excluded because they were related to technical aspects of cloud adoption. The 25 articles were classified into four categories that include business organizations (nine studies or 36%), educational institutions (five studies or 20%), IT professional (four studies or 16%), and end users (seven studies or 28%). The adoption theories and the methodology of each article were specified. The time period of the articles range from 2010 to 2015. We conducted a simple frequencies analysis of the factors that have been used by the researchers. For example, the nine studies of business organizations were exposed to extraction of factors and then frequencies analysis.

3. LITERATURE REVIEW
3.1 Definition
Cloud computing has many acceptable definitions because of the large scope of this technology and the complexity of its service relations. Cloud computing was defined by Erdogmus (2009) as a pool

of highly scalable, abstracted infrastructure is capable of hosting end-customer applications that are billed by consumption. Sultan (2010) defined cloud computing as IT capabilities that are requested, provisioned, delivered, and consumed in real time over the internet. Since this paper focuses on the adoption of cloud computing regardless of the disciplines that the technology is being utilizes, cloud computing is defined as the utilization of services, software, infrastructure, and platform using the internet.

3.2 Factors Influence Cloud Computing Adoption
The review of the factors is divided based on the users of the cloud computing services. Thus, the previous studies showed that the cloud has been used in business organizations, educational institute, individual users, and IT professionals.

3.2.1 Cloud computing in Business organizations
The majority of the studies regarding the cloud computing adoption have been conducted in business organizations. Gupta et al. (2013) investigated the usage and adoption of cloud computing by small and medium enterprises (SMEs). Using TAM model as an adoption theory, the findings indicated that ease of use and convenience are the biggest favorable factors followed by security and privacy and then comes the cost reduction. Similarly, Wu (2011) employed TAM and investigated the adoption of Software as a service (SaaS) business organizations and telecommunication companies. Finding showed that marketing effort, social influence, attitude toward technology, innovation, security and trust, perceived usefulness, and perceived ease of use have significant influence on the adoption. In the same vein, Stieninger and Nedbal (2014) have reviewed four adoption theories such as TOE, TAM, UTAUT, and DOI to investigate the factors that affect the adoption of SMEs of cloud computing. Using qualitative approach, the finding showed that in order of importance, image, relative advantage, perceived security, facilitating conditions, costs, perceived usefulness, effort expectation, technology availability, voluntariness of use, compatibility, performance expectancy, technology characteristic, trust, complexity, perceived ease of use, regularity framework, observability, triability, and energy efficiency are the factors that identified by the interviewees.

Borgman et al., (2013) conducted interviews with 24 global business companies to explore cloud computing adoption. They used TOE as adoption theory. The findings showed that technology (perceived advantage, perceived complexity, and perceived compatibility) and organizational (firm size, top management support, and skills of non-IT employees) are the most important factors for the adoption of cloud. Similarly, Alkhater et al. (2014) conducted a literature review study and incorporated TOE, DOI and Institutional theory to investigate the adoption of cloud in business organizations. Finding was a conceptual model that proposed many factors to influence the adoption of cloud computing. These included technological factors (availability, reliability, security, privacy, and trust), DOI (relative advantage, compatibility, and complexity), organizational factors (top management support, organization size, and technology readiness), and environmental factors (compliance with regulations, competitive pressure, trading partner pressure, and physical location). Based on case study approach, Morgan and Conboy (2013) conducted interviews with 14 top managements in three companies. The findings revealed that there are three main factors that influenced the adoption of cloud computing by the companies. These were technological factors (trialability, relative advantage, compatibility, and complexity), organizational factors (increased traceability and auditability, the desire to improve collaboration and promote openness both inside

and outside organizations, and the IT managers' fear of losing control of their IT environment), and environmental factors (security and legal issues).

Oliveria et al. (2014) use quantitative method to investigate the factors that affect the manufacturing and services sectors to adopt the cloud computing. DOI and TOE were used as theories of adoption. The findings revealed that innovation characteristic (relative advantage, complexity, compatibility, security concern, and cost saving), technology context (technology readiness), organizational context (top management support and firm size), and environmental context (competitive pressure and regulatory support) are the most significant factors. Similarly, Gangwar et al. (2015) used same methodology and employed TAM and TOE to find the factors that influence the adoption of cloud computing. The findings showed that technology (relative advantage, compatibility, and complexity), organization (organizational competency, training and education, and top management support), perceived usefulness, and perceived ease of use, are the most important factors.

Picoto et al. (2013) investigate the cloud computing usage and organizational mobility in European companies. The findings showed that convenience, compatibility, organizational innovativeness, entrepreneurial orientation, and trust in suppliers have significant influence on use of cloud computing. Organizational mobility mediates the relationship between use of cloud computing and performance.

3.2.2 Cloud Adoption in Education
Increasingly adoption of cloud computing in education is receiving attention from researchers. Lim et al. (2015) employed quantitative approach in an exploratory study to find the benefit and challenges of using cloud computing in Swedish schools. The findings indicated that the main benefits of cloud computing is the ability to allow users to access data and software anywhere as long as there is Internet access and the ability to facilitate sharing of learning materials and data. The biggest obstacle is the concerns about security and privacy of data.

Burda and Teuteberg (2014) employed TAM in a quantitative approach to find the role of trust and risk perception of adopting cloud storage by students in German universities. Findings showed that trust is influenced by satisfaction and reputation. Familiarity influences ease of use, which with trust influence the perceived usefulness. In addition, risk and perceived usefulness influence intention to use cloud storage. Cao et al. (2013) conducted similar study using UTAUT as adoption theory; they investigated quantitatively the adoption of cloud storage by students in China. The findings showed that perceived risks, perceived cost, personal innovativeness, performance expectancy, effort expectancy, social influence, and facilitating conditions affect the students' adoption of cloud storage. In science field, Yang et al. (2012) conducted a study by interviewing 22 experts to investigate the factors that influence the adoption of cloud computing. The findings suggest that cost, networking, and elasticity are the top three dominant factors influencing the adoption of cloud computing for science.

Recently, Arpaci et al. (2015) investigated the adoption of cloud computing in the educational institutions. TPB was used as adoption theory. The findings indicated that security and privacy have strong significant influence on the students' attitudes towards using cloud services in educational settings.

3.2.3 IT Professional Perspective of Cloud Adoption

Several studies have focused on the adoption of cloud computing from the IT experts and professional perspectives. Opitz et al. (2012) employed TAM in a quantitative approach to investigate the adoption of cloud in IT department in Germany. The findings showed that image, job relevance and perceived usefulness have significant influence on cloud computing acceptance. Similarly, Wu (2010) has used TAM and quantitative approach to investigate the adoption of SaaS. IT managers were the respondents of the study. The finding indicated that items of social influence, perceived usefulness, and security and trust are the most important elements that influence SaaS adoption.

Lian et al. (2014) investigated the adoption of cloud computing in Taiwan hospital. Theories of adoption used were TOE and HOT-fit model. Chief information Officers (CIOs) were the respondents of the study. The findings of the study indicated that data security, perceived technical competence, cost, top manager support, and complexity are the most important factors. Further, among the proposed four dimensions the most important one is technology followed by human, organizational, and environmental factors.

Lin and Chen (2012) investigated the cloud computing adoption in Taiwan using interview. DOI was the theory of adoption. Respondents were IT professional. The findings showed that the primary concerns that IT managers and software engineers have are compatibility of the cloud with companies' policy, IS development environment, and business needs; and relative advantages of adopting cloud solutions.

3.2.4 User Perspectives

Previous studies have focused on the end user perspectives of using the cloud computing technology. Lian (2015) used UTAUT and investigated quantitatively the factors that influence the adoption of E-invoicing using cloud computing. The findings showed that effort expectation, social influence, trust in e-government, and perceived risk have significant effects on the intention to adopt E-invoicing. Additionally, trust in e-government and perceived risk mediates the relationship between behavioral intention and security concerns regarding e-government. Gender differences moderate the relationship between social influence and behavioral intention. Age level is found to moderate the relationship between perceived risk and behavioral intention. Switching to cloud computing of end users were also investigated by Park and Ryoo (2013) using a two- factor theory perspectives, the findings showed that users' switching intention to cloud services was not only positively influenced by expected switching benefits whose antecedents are omnipresence of cloud services and collaboration support, but also negatively influenced by expected switching costs whose antecedents are satisfaction with incumbent IT and breath use of inclement IT. The impacts of switching benefits and costs on switching intention were also positively moderated by end users' personal innovativeness.

Phaphoom et al. (2015) investigated the major technical barriers to adopt cloud computing. Data was collected from employees and decision makers. The study compared between adopters and non-adopters. The comparison reveals three potential adoption inhibitor, security, data privacy, and portability.

In public service organization, Shin (2013) used TAM to investigate the factors that influence the adoption of cloud. Findings showed that user intentions and behaviors were largely influenced by

the perceived usefulness and ease of use. Perceived usefulness is influenced by availability, security, reliability, and access. Perceived ease of use is influenced by availability, and access. Subjective norm influences the intention. Similarly, TAM was also used by Shin (2015) to investigate the use of adoption of cloud services. Findings showed that availability, access, influenced ease of use and usefulness. Security influenced perceived usefulness only, while reliability influenced usefulness only. Intention was influenced by perceived usefulness and ease of use. Behavior to use was influenced by intention and subjective norm.

Park and Kim (2014) used TAM to investigate the use of mobile cloud computing by users. The findings showed that perceived usefulness, perceived connectedness, perceived security, service and system quality, attitude, satisfaction, and perceived mobility were the factors that influence the users of mobile cloud computing.

Yang et al. (2015) used DOI to investigate quantitatively the adoption of SaaS by users. The findings showed that three main constructs have significant influence on the intention and attitude toward SaaS. These were organizational readiness (IT infrastructure and top management support), Technological readiness (relative advantage, simplicity, compatibility, and experienceability), and environmental readiness (competitor pressure and partner pressure).

4. FINDING AND DISCUSSION

Many factors have been used by researchers to investigate the adoption of cloud computing by business organizations. Nine studies have been found in this area. Based on frequencies analysis that has been conducted on the studies that investigated the business adoption of cloud, it was found that the most frequently used factors, in order of importance, were security and privacy, relative advantage, compatibility, complexity, and ease of use. The emergent of these factors is due to the extensive use of DOI, TOE and TAM in the business related studies. TOE was used in five out of nine studies followed by DOI in four studies and TAM in four studies. UTAUT model was used only in one study.

In the educational area, five studies were found to investigate the educational adoption of cloud computing technology. TAM, UTAUT, and TPB are used in one study each. Other studies were exploratory and the last one did not specify the adoption theory. The most frequent factors that have been used by researchers to investigate the adoption of cloud computing in this area were risk, security and privacy, cost of adoption, and performance expectancy.

The IT professional perspective of the adoption of cloud computing were found in four studies. Two of these studies have used TAM followed TOE and DOI was used in one study each. The frequencies showed that the most important factors were ease of use, perceived usefulness, security and trust, complexity, compatibility, and relative advantage.

A total of seven studies have investigated the users perspectives of adopting cloud computing. Three of the studies have used TAM to investigate the adoption of users followed by UTAUT in one study and DOI in one as well. Two-factor theory was used in one study and the last study did not specify the use of any adoption theory. The factors that have been used by researchers based on the frequencies were security, perceived usefulness, and availability.

Table 1 summarizes the most important factors in the four areas of adoption of cloud computing.

Table 1: Most common factors

Factor/ Area	Business	Education	IT professional	Users
Security and privacy	X	X	X	X
Relative advantage	X		X	
Compatibility	X		X	
Complexity	X		X	
Ease of use	X		X	
Risk		X		
Cost		X		
Performance expectancy		X		
Perceived usefulness			X	X
Availability				X

The frequencies of the four adoption areas showed that security and privacy was the most important factors. There was great emphasis on the security from the business, educational, IT professional, and users' perspectives. This was followed by the factors of DOI namely relative advantage, complexity, and computability and equally the factors of TAM ease of use and perceived usefulness.

In term of the adoption theory models, TAM was used in ten studies, DOI in six models, TOE in six models; the least used adoption theory was UTAUT with three studies have used the model. However, the frequencies as was shown in Table 2 for the factors of DOI were high due to the fact that DOI and TOE are using the same factors. Gangwar et al. (2014) pointed out that DOI is part of TOE. It was noticed that UTAUT was the least used adoption theory. Many researchers have referred to UTAUT as the newer adoption model among others and it has exploratory power of 70%. In addition, it could strengthen the inadequacy of other models (Wang et al., 2011; Venketach et al., 2003; Alharbi, 2014; Cao et al., 2013; Mathur & Dhulla, 2014). Our finding is similar to those of Cao et al. (2013) who referred to the lack of UTAUT studies in cloud computing adoption.

Our findings also share the same opinion with other researchers regarding the extensive investigation of adoption of cloud in business organizations (Lim et al. 2015; Gangwar et al. 2015). It was noticed that the studies in educational field such as the adoption of cloud by universities or students has received less attention from researchers. This is in agreement with other researchers who referred to the lack of studies in academic domain (Gohary et al. 2013; Lim et al. 2015). We found also that a total of 20% of the studies or five studies only has used qualitative approach, the rest have used quantitative approaches.

5. CONCLUSION AND DIRECTION FOR FUTURE RESEARCH

This study was conducted to find the factors that affect the adoption of cloud computing by business organizations, educational institutions, IT professional, and end users. The study also tries to provide reference for decision makers in adopting cloud computing. The review included 25 related articles that have investigated the factors in the four domains. We have conducted systematic review where the studies sorted based on the respondents of the study. Nine articles were related to business organizations, followed by seven in end users, five studies in educational institutions, and four from IT professional perspectives. The finding of the review showed that in business organizations, the most important factors of cloud adoption were security and privacy, relative

advantage, compatibility, complexity, and ease of use. In education institutions, the factors that affected the adoption were risk, security and privacy, cost of adoption, and performance expectancy. From user perspectives, factors were security, perceived usefulness, and availability. Lastly, from IT professional perspectives, the factors were ease of use, perceived usefulness, security and trust, complexity, compatibility, and relative advantage. Overall, we found that security and privacy was the most frequent factor to be incorporated and tested by researchers in the four domains. This was followed by a set of variables that belong to DOI such as relative advantage, complexity, and computability and other that belong to TAM such as ease of use and perceived usefulness.

Our findings also indicated that the most used adoption theories were in order of frequencies TAM, TOE, DOI, and UTAUT. In addition, the majority of the studies have used quantitative approach. Only few studies focused on the user of qualitative approach, which have used instruments such as interview and case study.

Based on the literature and the findings of this study, it could be suggested for future researchers that to focus on the use of qualitative approach. This is based on the fact that cloud computing adoption is still new area and the need for qualitative approach is vital to discover the dimensions of this phenomenon. Little academic studies have investigated the adoption of cloud in educational institutions and only three studies have employed UTAUT. Thus, it is recommended that future studies investigate the adoption of cloud computing in educational institution using UTAUT as a theory of adoption. Security must be one of the key factors in any future research. This is because the security aspect was identified as the most common factors among all reviewed studies.

IT professional perspectives were the least frequent domain among others. The future work is recommended to conduct studies using a questionnaire approach to gather larger amount of information about the adoption of cloud computing from IT professional and experts in cloud computing.

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