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A Review of the Factors that Influence the Adoption of Cloud Computing by Small and Medium Enterprises

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Abstract: Cloud computing has emerged as a solution for companies with limited financial capabilities. Using cloud computing gives the companies extra capabilities. Previous studies attempted to find the factors that influence the adoption of cloud computing. However, the majority has focused on technical issues of the adoption. An agreement on the factors that influence the adoption of cloud computing has not yet arrived. Thus, the purpose of this study is to review the literature and integrate the view of previous studies to find the factors that influence the adoption of cloud computing. The study aims to develop a conceptual model. Twelve models of those who investigated the adoption of cloud computing were reviewed and analyzed. Factors that influence the adoption were extracted from the models. The most frequent factors were proposed to influence the adoption of cloud computing. The finding of this study suggested that perceived ease of use, perceived usefulness, security, compatibility, cost, and top management support are the factors that influence the adoption of cloud computing. Recommendation for future work included qualitative study and empirical testing of the proposed model.

Keywords: Cloud computing, TAM, Security, Cost, Top management support, TOE, SMEs.

INTRODUCTION

Enormous changes have been caused by the development of Information Technology (IT). Mainly the changes have occurred in the business operation and in the process creation of new product and services for emerging and changeable needs of customers. In addition to the ways how businesses use the technology to compete with each other and create competitive advantages [1]. The need for business to use the technology has become indispensable. However, the businesses required having the required resources such as the IT infrastructure, software, and hardware and that might be out of the businesses capabilities [2]. Business with little capabilities could not implement the technology on their own limited budget. However, the introduction of cloud computing technology and wide spread of the providers have made it possible for all companies scales to implement cloud computing. [3].

Cloud computing is a new technology that uses large collection of IT resources available and accessible virtually [4]. Cloud Computing is the use of internet to present cloud image. On demand access to services are provided to customers to use the software, hardware, and infrastructure to conduct their operations and transactions. Cloud computing was described as a grid computing, utility computing, virtualization, and clustering. It was described also as a new kind of public utility since it makes it possible for computer resources to be reconfigured to match varying service demands [5].

Researchers have pointed that the technology of cloud computing has been tested in several fields which include IT industry, academia, manufacturing, services, healthcare, and electronic commerce by several providers of the service such as Amazon, IBM, Nimbus and Eucalyptus [6]. Later on the cloud, computing has become one of the most famous term that are being used in the IT industry. Most research projected that the next generation of technology use will be based mainly on cloud computing technology which links all components such as organizational components, software, hardware, and IT system together to solve the emerging issues of organization and reduce the operational cost of conducting businesses [7].

Many researchers have attempted to identify the factors that influence the adoption of cloud computing. While some have investigated the readiness and acceptance of the organization to make a decision to adopt the cloud [2, 8, 9]. Other has limited the scope and investigated the technical conditions to adopt the cloud computing. Researchers have no general agreement on what factors that influence the adoption of cloud computing. Thus, this study is reviewing and integrating the view of the researchers to find the factors that influence the adoption of cloud computing.

This study consists of five sections. First section presents the introduction to the study and highlights the issues and the objectives. Second section reviews the literature and the work of other researchers to develop a solid view of the factors that influence the adoption of cloud computing. Third section presents the research methodology. Fourth section presents the findings and a conceptual model of the factors that influence the adoption of cloud computing with the related discussion and arguments. Last section presents the conclusion of the study.

LITERATURE REVIEW

Overview and Definition of Cloud computing

Cloud computing is a new concept that is continuously being developed and defined. It provides low cost elements to businesses and individuals. Embedding massive and expensive software in a network is not cost efficient; in cloud computing, software are already embedded online and ample applications are available for free [10]. Cloud computing helps small businesses, as well as large companies and corporations, to decrease IT expenditures. Thus, this technology provides an equal platform for every enterprise [11].

Cloud computing has many acceptable definitions because of the large scope of this technology and the complexity of its service relations. A highly cited definition was given by the US National Institute of Standards and Technology (NIST). NIST defined cloud computing as "a model that enables convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction" [12]. The definition indicates that there are four main categories of cloud services that include cloud providers and infrastructures, cloud platforms, cloud software, and cloud data storages. In term of classification, researchers have pointed out that there are three main classifications, which are infrastructure as a service (IaaS), platform as a service (Paas), and software as a service (SaaS). Weinhardt et al. [13] described the layers of cloud computing as encapsulate functionality from the layers beneath by aggregating and extending service components via composition and mash-up technologies." Most of the definition are focusing on the technical and layers of the cloud computing. In this study, cloud computing is defined as the accessibility of Internet-based services that are provided by service providers for certain fees.

Adoption of Cloud Services

The technology of cloud services mainly consists of many components that include cluster of computing, centralization of data, broadband, network, and grid computing. This components is being used widely and especially in tourism industry, economic, online trade, and medical industry [15]. Cost saving is one of the key advantage in the cloud computing services. The saving is not only in money but also in time and effort needed to operate the system and conduct the business [15]. It has been witnessed that cloud computing services have been one of the most successful business model in the world of businesses. Therefore, many IT corporations have developed cloud architecture to provide adaptive cloud services to any organization or customer.

Cost is one of the most important factors to adopt cloud computing. A survey of 700 company managers found that the main reason behind the adoption of cloud solutions is the need to cut costs. Furthermore, company budgets usually cannot cover the costs of traditional IT solutions. On the basis of the study on IT adoption, [16] classifies two types of technology adoption: (1) technologies that exhibit a lack of user interdependencies and substantial knowledge barriers faced by potential adopters; (2) technologies are characterized by significant user interdependencies or high knowledge barriers. Most cloud services follow the second classification because of the high knowledge provided by PaaS and SaaS for user interdependency. Therefore, cloud services are developed for SMEs and large businesses rather than for individual tasks.

Benlian [17] explain that two main issues exist in the adoption equation of any organization: cost reduction and service performance maximization. Ross [18] pointed out that interest in cloud computing is widespread, and the available options for cloud computing are continuously growing. Cloud computing has many advantages, including economy of scale and the availability of large computing resources to many users. In addition, cloud providers can keep a very high level of availability, often with considerably less downtime than individual organizations [18].

Richardson [19] illustrate the gap between the potential and the actual users of cloud computing based

on survey results, which reveal that eleven percent of the firms of the respondents currently use cloud computing for data and information storage, with another nineteen percent considering using cloud computing. Hence, seventy percent of the respondents show little interest in cloud computing. As the technology matures and as other market incentives become available, additional firms are expected to embrace cloud computing or similar technologies.

The Existing Cloud Computing Adoption Models

Since the inception of cloud computing in 2007, many academic studies have attempted to discover the factors that affect the adoption of SMEs and large companies. In this review of the existing models, the studies pertaining to large scale are included due to the lack of studies on SMEs. Pauqet [8] employed technology acceptance model to find the factor that affect the adoption of consumers to cloud computing. Findings of the quantitative study showed that perceived usefulness, perceived ease of use, organization type, and security has strong association with the adoption of cloud computing [20]. Has used TAM as well along with factors from other models to examine the factors that affect the adoption of cloud computing. The findings showed that ease of use, usefulness, security, trust, attitude, and market effort have significant influence.

Ekufu [2] examines the factors that influence the decisions of organizations to adopt cloud computing technology by using the TAM and theory of planned behavior. These factors are attitude, subjective norm, behavioral control, perceived usefulness, perceived ease of use, and behavioral intent.

Park and Kim [21] examined the effectiveness of TAM in determining the factors that affect cloud computing adoption. The findings showed that usefulness, connectedness, security, service and system quality, attitude, satisfaction and perceived mobility are the factors that influence the adoption of cloud computing.

Other adoptions models such as Technology-Organization-Environment (TOE) have been used by other researchers to explain the adoption of cloud computing. [22] consider technological, organizational, and environmental factors with related sub-factors in developing an SME cloud computing adoption model that is theoretically grounded on the technology–organization–environment framework and found that these three factors influences the adoption of cloud computing [23]. Employed the same theoretical adoption theory to find the cloud computing factors. The findings showed that convenience, compatibility, organizational innovativeness, entrepreneurial orientation, trust in suppliers have significant influence on use of cloud computing. Organizational mobility mediates the relationship between use of cloud computing and performance.

Gangwar et al. [24] merged between TOE and TAM to examine the factors that affect the cloud computing adoption. The findings showed that relative advantage, compatibility, complexity, organizational competency, training and education, top management support, usefulness, and ease of use are the factors that affect the adoption of cloud computing. Oliveira et al. [25] used similar approach and employed TOE to find the factor of cloud. The findings showed that innovation characteristic have strong influence on cloud computing adoption. Similarly, technology context and organizational and environmental context have strong influence on the adoption of cloud computing.

RESEARCH METHODOLOGY

This study is a quantitative in nature. The purpose of the study was to find the factors that affect the adoption of cloud computing by SMEs. Therefore, search engine was used to identify the related articles. Keyword such as cloud computing, factors, SMEs, adoption, TAM, TOE, and a combination between these terms has been employed. As a result, more than 60 articles were identified. However, the related articles that pertaining to the topic was 12 articles. The articles' time period range from 2010 to 2015. A frequency analysis was performed on the findings of the articles to identify the most frequent and used variables that are related to the adoption of cloud computing services by SMEs.

FINDINGS

A frequency analysis is conducted on the variables to find out the most used factors. Table 1 shows the extracted factors from the reviewed articles. The table shows the variables and their frequencies.

Based on Table-1 the most frequent factors are presented in table 2. Only variables with frequency of three times or more are presented.

Based on the literature review and the above analysis of the factors that extracted from the models and have frequency more than three times, conceptual model of this study is presented in Figure 1.

Table-1: Extracted Factors from the Reviewed Models

Variable	Frequency
Cost	3
Need for cloud	1
Reliability	1
Security	5
Perceived usefulness	5
Perceived ease of use	5
Organization type	1
Marketing effort	1
Social influence	1
Attitude toward technology	2
Innovation	2
Lack of interoperatibility	1
Convenience	1
Compatibility	3
IT know how	1
Entrepreneurial orientation	1
Trust in supplier `	1
Competitive pressure `	2
Relative advantage	2
Complexity	2
Organizational competency	2
Training and education	1
Top management support	3
Perceived connectedness	1
Service and system quality	1
Satisfaction	1
Perceived mobility	1
Firm size	1

Table-2: Most Frequent Factors

Factor	Frequency
Perceived ease of use	5
Perceived usefulness	5
Security	5
Compatibility	3
Cost	3
Top management support	3

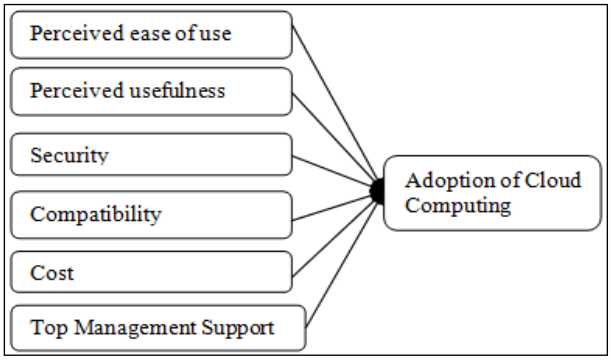

Fig-1: Conceptual Model

Cloud computing adoption is the dependent variables of this study. Reviewing the literature, it has been found that the TAM model has been used intensively in explaining the adoption decision of SMEs and other large scales companies. Perceived ease of use and perceived usefulness were extracted from the literature as they have been used widely in explaining the adoption. Security of the data of companies has been major concern for the decision makers when they think about adoption cloud computing. Compatibility of the technology with the existing structure, technology, and culture also highlighted by the theory of TOE and incorporated and tested on the adoption of cloud computing. Cost of adoption for small companies is a big issue as they known by their limited capabilities. Lastly, the top management support is essential for the success of the adoption and for the adoption itself. Based on the literature, the six variables were considered as the most important factors that influence the adoption of cloud computing.

Perceived Ease of Use

Perceived ease of use was defined by [26] as "the degree to which a person believes that using a particular system would be free from effort". Employees in small business usually work outside of the office location and thus by using the cloud computing, they will be able to access their data using mobile device or any other tool that enables them to do so in a big plus [21]. The cloud computing technology allows users to access their work from anywhere at any time with any portable device and reduce the administrative cost for running the business [11, 40]. Less powerful devices (smartphones, netbooks) are able to make the most of the company's backend IT systems via a simple web-based interface [27, 41].

Perceived Usefulness

Perceived usefulness is defined as the degree in which the user perceives the specific technology will increase his or her job performance [26]. Several studies (e.g. [21, 28, 42-44] have replicated TAM model and demonstrated that perceived usefulness have positive effects on user attitude and behavioral intention

Security

Security has been one of the major issue for the adoption of cloud computing. A study conducted by [29] has pointed out that more than 75% of the respondents who are chief information officers have shown deep concern about the security of cloud computing and they have argued that data are not encrypt on their servers. Security directly contributes to the reliability of the system. A reliable software system is a system with reliable security. Hence, designing a highly secure cloud system is very important [30, 45-47].

Compatibility

Compatibility is one of the contracts of the TOE and it is defined as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters". It was found by researchers that the lack of compatibility of the new technology with the existing IT and individual needs lead to negative effect on the adoption and use of the technology [22]. Studies that have been conducted in this regard showed that the compatibility of the information system strongly affects the adoption decision of new technology [31].

Cost

Companies have managed to save up to 70% of the operational cost since they have started adopting the cloud computing services using Amazon web services as the cloud service providers [32]. Startups and small businesses can now afford applications such as ERP (Enterprise Resource Planning), CRM (Customer Relation-ship Management), and SCM (Supply Chain Management) due to economical subscription fees [33, 34, 35]. Thus, the cost issue can be solved by adopting cloud computing.

Top Management Support

Top management includes the level of centralization, the distribution of power and control, information links, the availability of slack resources, lateral communication, firm size, and top management support [36- 39]. Of these, top management support and firm size are the most important factors for assessing the adoption of cloud computing [36].

CONCLUSION

This study aimed to review the literature and develop a conceptual model that reflects the factors that influence the adoption of cloud computing. The literature was reviewed and analyzed. Most extracted factors in the literature were listed. The frequency of the factors was identified. Based on the findings, the use of TAM model is clear in the literature. Researchers incorporated perceived ease of use and perceived usefulness as factors that influence the adoption of cloud computing. Similarly, this study does. The study predicted that the ease of use of cloud computing will influence the adoption of cloud computing. Perceived usefulness or the expected benefits of the adoption have a vital role in the adoption and the study predicted that the adoption is dependent on the cloud computing usefulness. Security of the cloud computing is still one of the ongoing issues. Thus, the study predicted that the level of security would influence the adoption. Similarly, the compatibility of the system with the existing systems, culture, structure of the organization will have important role in the adoption of cloud computing. Cost of the adoption has been always one of the major foundation for the adoption of cloud computing. The study predicted that cost will influence the adoption of cloud computing. Lastly, the study predicted that the support of top management for the adoption is essential.

Studies in cloud computing is still in its infancy, more studies are required to cover this field. Most of the reviewed studies were quantitative based on a questionnaire distributed to the CEO or the top management of the companies. It is recommended that future work investigate the adoption of cloud computing by conducting qualitative study.

This study has developed a conceptual model. It is recommended for future work to test this model empirically by developing a questionnaire and collecting data from large-scale companies or small companies.

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