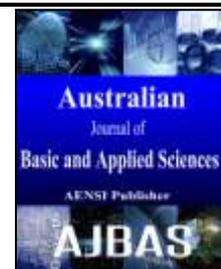




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Cloud Computing Adoption by Business Organization: A Systematic Review

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ABSTRACT

Background: Cloud computing is a new technology that can provide benefits to all stakeholders. Most of the studies attempted to find the factors that affect the adoption of this technology. However, the findings of these studies still inconclusive. In addition, the theoretical models that are used are varied. Therefore, the purpose of this paper is to review, integrate and consolidate the literature to identify the factor that affect the adoption of cloud computing by business organization. **Objectives:** The objectives of this paper is to identify the factors that affect the adoption of cloud computing technology by business organizations. In addition, the paper aims to provide a clear understanding about the current situation of the research in the cloud computing technology. To fulfill these objectives, a process to refine the related articles was followed. As a result, a total of 27 articles were considered related to the topic of this study. A frequency analysis was conducted on these articles. **Findings:** the finding showed that security, compatibility, relative advantage, complexity, privacy, ease of use and usefulness are the most important variables for the adoption of cloud computing by business organization. The Technology Acceptance Model (TAM) is the most deployed theoretical model. High percentage of the studies were conducted in emerging economies and particularly on high tech companies. Quantitative studies outperform qualitative studies. IT professional was the unit analysis of majority of the studies. **Conclusion:** Decision makers can benefit from this paper in the sense that the most important factors are identified so that focusing on these factors yield better adoption rate of cloud computing. Findings of previous studies are inconclusive regarding the factors that affect the cloud adoption. This study reviewed the literature and consolidated the views of previous studies. Direction of future works are given and discussed to extend the findings of this study.

INTRODUCTION

Cloud computing is considered as a new paradigm in the Information Technology (IT) that has originated in 2007(Nasir & Niazi 2011). It is a result of innovations in Internet technologies, hardware technologies, systems management, and distributed computing (Buyya 2013). It is a dynamic technology platform that addresses a wide range of needs by providing cyber-infrastructure to maintain and extend information storage capabilities. In addition, cloud computing provides access to software and hardware without large capital investment and provides easier access to applications and services that can be realized with minimal service provider interaction (Yang, Hwang, & Yuan, 2012). This has enabled cloud computing to develop as a technological innovation that can handle large amounts of information that are transferred and stored via electronic applications (Leymann *et al.* 2011).

Prior works on cloud computing attempted to find the factors that encourage users to adopt and use the technology. Several studies have used the Technology Acceptance Model (TAM) by (Davis 1989) while other

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found that Models such unified theory of acceptance and use of technology (UTAUT) by (Venkatesh *et al.* 2003), Diffusion of Innovation (DOI) (Rogers 1995), and Technology-Organization-Environment framework (TOE) by (Tornatzky & Fleischer 1990) have also contributed greatly to the understanding of the factors that affect and can explain the variation in the adoption of technology. Nevertheless, previous studies has no general agreement on either the factors or the theories that can be used as a reference to explain the adoption of technology.

Consequently, the purpose of this paper is to identify the factors that affect the adoption of cloud computing as well as to find the most prevailing theories and statistics related to the adoption of cloud computing by users. The paper consists of eight sections. First section has introduced the topic and highlighted the issues of this study as well as the objective. The methodology of this paper is given in second section followed by the literature review in the third section. Fourth section presents the findings followed by the discussion in fifth section. Limitation of this paper as well as direction for future work are given in sixth and seventh section respectively. Last section concludes the paper.

2. Research Methodology:

This study is a quantitative in nature. It reviews the existing literature to identify the factors that affect the cloud computing adoption. Key words such as adoption of cloud computing, factors affect cloud computing, cloud computing, adoption theory, and a combination of these words were used to identify the related articles that fit in the context of this study. The period of the articles was between 2011 and 2017 other articles that earlier than 2011 were not considered due to the fact that cloud computing widely spread during the year 2011. Majority of the articles were taken from emerald (91), science direct (109) and IEEE (41). A screening process was conducted to refine the articles and focus on only those that are related to topic of this paper. As a result, a total of 27 articles were considered in this study. Figure 1 shows the process of refining the articles.

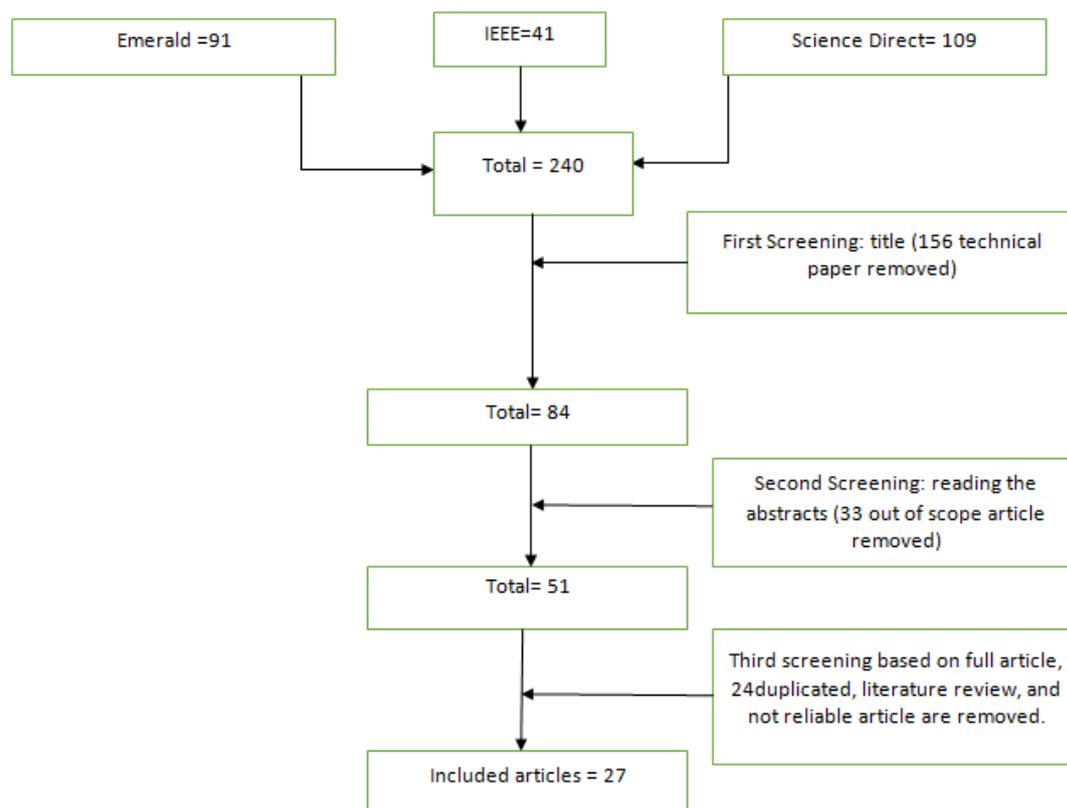


Fig. 1: Process of Selection the Related Articles

3. Literature Review:

This section discusses the definition, layers, and deployment of cloud computing. It also discusses the factors that affect the cloud computing adoption.

3.1 Cloud computing:

Cloud computing is a newly emerged technology and it has been adopted in several industries to facilitate the sharing of resources such as software, hardware, and application. Many stakeholders can benefit from the cloud and this includes the developers, network architects and end users (Gangwar *et al.* 2015; Lian 2015; Flack & Dembla 2014). The most cited definition of cloud computing is provided by the US National Institute of Standards and Technology (NIST), which refers to cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell & Grance 2011).

Cloud computing has three main layers that include software as a service or known as SaaS and platform as a service also known as PaaS, and infrastructure as a service known as IaaS (Han, 2013; Mavodza, 2013; Yang, Sun, Zhang, & Wang, 2015). Each layer is designed to serve specific stakeholders. For example, SaaS is designed to provide services for end users, PaaS is designed to serve developers, while IaaS is designed to serve the network architects (Prasad *et al.* 2014; Höfer & Karagiannis 2011). In this paper, the focus is only on SaaS because this paper is reviewing the factors that affect the adoption by end users who are the proxies of the organization.

Several deployments can be found in cloud computing. Researchers agreed to classify cloud computing into four main deployment. First deployment is the public cloud which is offered by established companies such as Microsoft while the second deployment is the private cloud where companies hold the servers on their premises. The third deployment is called hybrid cloud which is a mix of private and public and lastly, the fourth deployment is the community cloud which is similar to the concept of alliance between companies to share the cloud servers (Buyya, 2013; Gupta and Thakur, 2014; Ramachandran *et al.*, 2014).

3.2 Factors affect cloud computing adoption:

Several studies attempted to identify the factors that affect the adoption of cloud computing by business organization. This is because using technology will improve the organizational performance of these organizations (Alaarj *et al.* 2016). As a result, variety of findings were derived and several theoretical adoption theories have been used to explain the adoption. For example, the TAM model has been used in several studies. Opitz, Langkau, Schmidt and Kolbe (2012) examined the adoption of cloud computing by IT professionals in Germany using the TAM model. The findings indicate that factors such as image, job relevance and perceived usefulness have affected the acceptance and use of cloud computing by IT professionals in Germany. Similarly, Gupta, Seetharaman and Raj (2013) deployed the TAM model to identify the factors that affect the cloud computing adoption by Small and Medium Enterprises (SMEs) in Malaysia using data collected from the managers of these SMEs. The finding showed that ease of use and convenience is the biggest favorable factor followed by security and privacy and then comes the cost reduction. Shin (2013) also examined the adoption of cloud computing in public sector organization using TAM and collecting data via interview as well as questionnaire. The findings emphasized on the importance of usefulness and ease of use for the adoption. In addition, the finding also indicated that availability, security, reliability, and access affect positively the perception of usefulness while the availability and access only affect the perception of ease of use. Intention to adopt cloud computing is also affected by subjective norms.

More studies have used TAM. For example, Burda and Teuteberg, (2014) utilized TAM to examine the adoption of cloud storage in Germany. The findings showed that risk and usefulness affect the adoption of cloud storage. In addition, familiarity with cloud affects the ease of use while familiarity and satisfaction affect the trust in cloud storage. In the same vein, Shin (2014) uses the TAM model to examine the adoption of cloud services in Korea. The findings indicated that availability and access affect the ease of use and usefulness. In addition, security and reliability affected the usefulness which with ease of use affect the cloud computing adoption intention. Subjective norms and intention affect the cloud computing behaviour. Wu (2011b) investigated the adoption of cloud computing in Taiwan using TAM. The finding showed that market effort, social influence, attitude, innovation, security and trust, usefulness, and ease of use affect the adoption of cloud computing.

Park and Kim (2014) also deployed the TAM model in Korean mobile cloud computing. Data collected from 1099 respondents and finding showed that perceived usefulness, connectedness, security, service and system quality, attitude, satisfaction and mobility are important factors for the adoption of mobile cloud computing in Korea. Arpacı (2016) investigated the adoption of cloud in Malaysia using the TAM and collecting data from 262 users. The findings indicated that perceived usefulness, subjective norms, and trust has a significant effect on attitude which has a significant effect on intention to use cloud computing. Xu, Tian, Xu, Reyes Ayala and Shen (2017) investigated the adoption of cloud computing via mobile and deployed the TAM model. The authors collected data from 419 individuals using questionnaire. The findings indicated that switching intention is affected by perceived usefulness and disconfirmation. Switching cost has negative effect on switching intention which in turn has positive effect on behaviour.

Several studies used different adoption theory such as UTAUT, DOI and TOE. For example, the TOE framework was used in the study of Phaphoom, Wang, Samuel, Helmer, and Abrahamsson (2015) in UK who investigated the adoption of cloud among employees and decision makers. The finding indicated that there are three potential adoption inhibitor which are security, data privacy, and portability. Yang, Sun, Zhang, and Wang, (2015) investigated the readiness to use SaaS by Chinese companies. The findings indicated that organizational readiness factor (IT infrastructure, top management support), technological readiness factors (relative advantage, simplicity, computability, experienceability), and environmental readiness (competitor, and business partner pressure) have significant effect on the readiness to adopt SaaS. Morgan and Conboy (2013) also utilized TOE to investigate the adoption of cloud computing by Irish companies. The finding indicated that technological, organizational and environmental factors have significant effect on the adoption. Low *et al.* (2011) used the TOE to examine the adoption of cloud among high tech Taiwanese companies. The findings revealed that relative advantage, top management support, firm size, competitive pressure, and trading partner pressure characteristics have a significant effect on the adoption of cloud computing. In Ghana, Senyo *et al.* (2016) examined the adoption of cloud computing by IT professional and managers. TOE factors found to be significant in the context of cloud computing adoption in developing countries. Alkhatere *et al.* (2015) examined the adoption of cloud computing among SMEs in Saudi Arabia. The findings showed that all the factors of TOE are significant predictors of the adoption.

Polyviou *et al.* (2015) conducted a qualitative study in six European countries and found that from technological perspective, relative advantage compatibility, and complexity are important factors. From organizational perspective, desire for interoperability, reduction of IT management overheads, need for meeting security and environmental policies, and transparency of processes desire were identified to be positively influencing the adoption. From environmental context, bureaucracy, political matters and legal issues seem to be influencing cloud adoption in the public sector. Similarly, In Jordan, Sulaiman and Magaireah (2014) investigated the adoption of cloud computing among hospitals. An interview with five IT experts showed that adoption of cloud computing in the healthcare is affected by Technological context, which include privacy, security, and reliability. From organizational context the factors include top management support, and technology readiness. Lastly, from environmental context the factors include government policy, legal environment, and competition.

The UTAUT model was also used in the literature. Cao, Bi and Wang (2014) investigated the users' adoption of cloud computing using UTAUT model and they found that risk, innovativeness, performance expectancy, effort expectancy, and social influence affect the behavioral intention to adopt cloud storage while facilitating condition and behavioral intention affect the use behaviour in China. Bellaaj, Zekri and Albugami (2015) deployed UTAUT to find the factors that affect the cloud computing adoption in Saudi Arabia. The finding showed that performance expectancy, effort expectancy, social influence affect the intention to use cloud computing. In addition, gender and experience were found to moderate the effect among the variables.

The diffusion of Innovation (DOI) also utilized in previous studies. For example, the study of Lin and Chen (2012) interviewed IT professional to identify the factors that affect the cloud computing adoption in Taiwan. The finding showed that compatibility, business needs, security, standardization, and relative advantage are among the concerns of companies when it comes to the adoption of cloud computing. Researchers also used the theory of planned behaviour (TPB). Arpaciet *et al.* (2015) deployed the theory to examine the use of cloud computing in educational institution in Turkey. The result indicated that security, privacy affect significantly the attitude which in turn affect the intention. Intention affected the educational use of cloud computing. Park and Ryoo (2013) deployed the two factors theory in United States (US) and found that users' switching intention to cloud services was positively affected by switching benefits whose antecedents are omnipresence of cloud services and collaboration support. The intention also was affected negatively by switching costs whose antecedents are satisfaction with incumbent IT and breath use of inclement IT. In addition, innovativeness moderated the effect of the benefit and cost on the switching intention.

Combining theories is the norm of the literature. In UTAUT, Venkatesh *et al.* (2003) combined eight models to come up with their UTAUT mode. Research also combined theories and model to increase the explanation of the variation in the adoption of cloud computing. Wu (2011a) combined TAM with Rough set theory to identify the factors that affect the SaaS adoption in Taiwanese high tech companies. The findings showed that items of social influence, perceived usefulness, security, and trust are the most important element that affect the adoption of SaaS. Oliveira, Thomas and Espadanal (2014) combined TAM and DOI to investigate the cloud computing adoption between Portugal service and manufacturing companies. The findings showed that innovation characteristic, technology, organizational, and environmental context factors have significant effect on cloud computing adoption. TAM was also combined with TOE in the study of Gangware *et al.* (2015) to investigate the adoption of cloud computing among finance and manufacturing companies in India. The findings showed that technological factors (relative advantage, compatibility, and complexity), organizational factors (organizational competency, training and education, and top management support) as well as the usefulness and ease of use have significant effect on cloud computing adoption.

TOE and human-organization-technology fit were combined in the study Lian *et al.* (2014) to investigate the adoption of cloud computing in Taiwanese hospital. The finding 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. Shiau and Chau (2016) examined six theoretical model that are service quality (SQ), self-efficacy (SE), the motivational model (MM), TAM, the theory of reasoned action or theory of planned behavior (TRA/TPB), and DOI. The six theoretical model and the combined model showed acceptable explanatory power that can explain the adoption of cloud computing. Table 1 shows a brief summary of the review articles. It shows the authors, country, industry, sample size, statistical method, adoption theory, and unit of analysis.

Table 1: Summary of the reviewed Articles

Author (s)	Country	Industry	Method	Adoption Theory	Sample Size	Unit of Analysis
Opitz <i>et al.</i> (2012)	Germany	IT Companies	Quantitative	TAM	100	IT professional
Gupta <i>et al.</i> (2013)	Malaysia	SMEs	Quantitative	TAM	211	Managers
Park and Ryoo, (2013)	USA	Education	Quantitative	Two factors theory	188	Students
Phaphoom <i>et al.</i> (2015)	UK	Several industry	Quantitative	TOE	352	Managers
Wu(2011a)	Taiwan	High tech	Quantitative	TAM and Rough Set Theory	246	IT professional
Lian <i>et al.</i> (2014)	Taiwan	Hospital	Quantitative	TOE and Human-Organization-Technology fit	60	IT professional
Shin(2013)	Korea	Public organization	Mix method	TAM	30	users
Burda and Teuteberg (2014)	Germany	Education	Quantitative	TAM	229	Users
Shin(2014)	Korea	Public organization	Quantitative	TAM	329	Users
Wu(2011b)	Taiwan	High tech	Quantitative	TAM	42	Managers
Park and Kim, (2014)	Korea	Communication companies	Quantitative	TAM	1099	Users
Oliveira <i>et al.</i> (2014)	Portugal	Service and manufacturing	Quantitative	TAM and DOI	369	Managers
Gangwar <i>et al.</i> (2015)	India	SMEs	Quantitative	TOE and TAM	289	Managers
Lin and Chen(2012)	Taiwan	General	Qualitative	DOI	-	IT professional
Arpaci <i>et al.</i> (2015)	Turkey	Education	Quantitative	TPB	200	Student
Yang <i>et al.</i> (2015)	China	Public and private	Quantitative	TOE	173	Manager
Cao, Bi, and Wang, (2014)	China	Education	Quantitative	UTAUT	225	Users
Morgan and Conboy(2013)	Ireland	High tech	Qualitative	TOE	-	Managers
Low, Chen and Wu, (2011)	Taiwan	High tech	Quantitative	TOE	111	IT professional
Senyo, Effah and Addae(2016)	Ghana	Several industries	Quantitative	TOE	305	IT professional
Alkhater, Wills and Walters(2015)	Saudi Arabia	Several industries	Quantitative	TOE	30	IT professional
Bellaaj <i>et al.</i> , (2015)	Saudi Arabia	SMEs	Quantitative	UTAUT	103	IT professional
Shiau and Chau(2016)	Taiwan	Education	Quantitative	SQ, SE, MM, TAM, TRA/TPB, DOI	487	Student
Arpaci(2016)	Malaysia	Education	Quantitative	TAM	262	Student
Polyviou and Pouloudi(2015)	Six Europe	Public sector	Qualitative	TOE	-	Public Manager
Sulaiman and Magaireah(2014)	Jordan	Hospital	Qualitative	TOE	-	IT professional
Xu <i>et al.</i> (2017)	China	High tech	Quantitative	TAM	419	Users

4. Findings:

The findings of this study are based on frequency analysis that have been conducted on the reviewed articles. First most important factors are presented followed by the most prevalent theoretical model, countries, sectors, methodological approach, sample size, and unit of analysis.

4.1 Factors affect the Cloud computing adoption:

Factors that affect the adoption were extracted from each article and the result of analysis showed that the most important factor for the adoption of cloud computing is the security (17) followed compatibility (14), relative advantage (12), complexity (11), privacy, ease of use and usefulness with frequency of ten for each. Top management support (9) is one of the important factors followed by technology readiness, competitive pressure, trust, with seven frequencies for each and personal innovativeness, reliability, and cost with six frequency of each. Figure 2 shows the frequency of the factors.

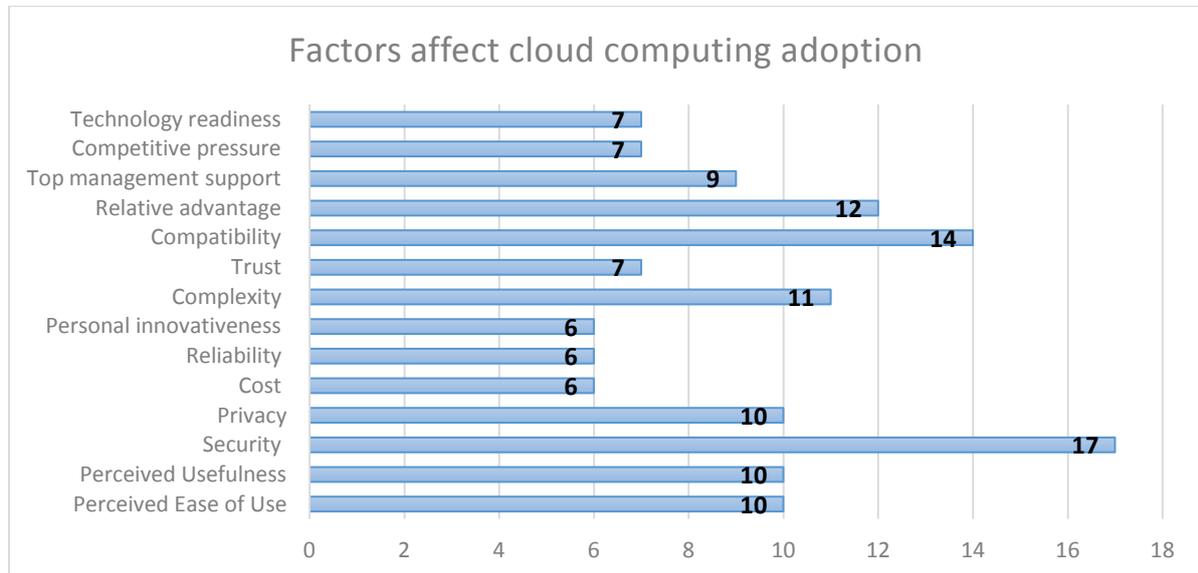


Fig. 2: Frequency of the Factors

4.2 Theoretical model:

The theories that have been used in previous studies are shown in Figure 3. It shows that a total of 37% of the studies have used TAM followed by 28% deployed TOE, and UTAUT (6%), TPB (6%), DOI (6%).

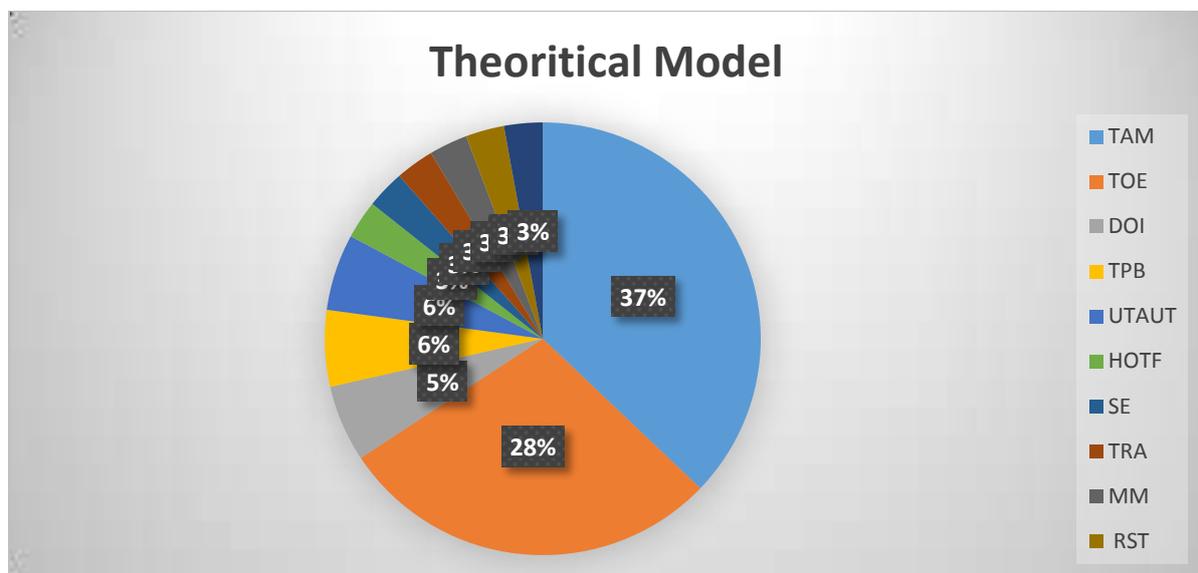


Fig. 3: Theoretical Model

In addition, some of the studies have used single theoretical model and other have combined two or more models. Figure 4 shows that 81% of the studies used single theory while 19% has combined two theories or more.

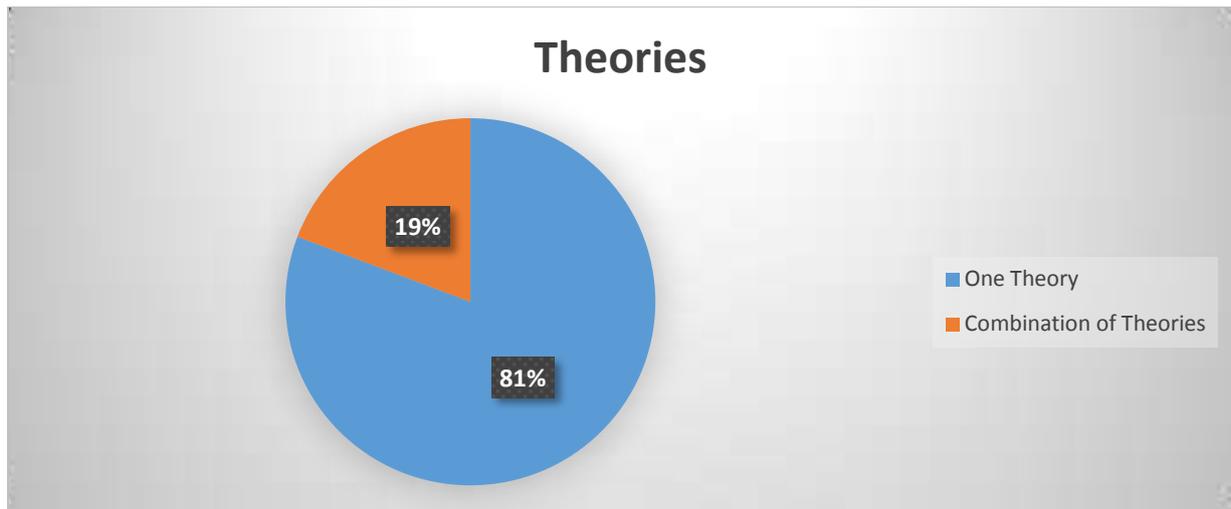


Fig. 4: Theories

4.3 Countries:

Majority of the studies were conducted in Taiwan (25%) followed by Korea (13%), Germany (9%), Malaysia (9%), Saudi Arabia (8%). Figure 5 shows the distribution of the countries where the studies have been conducted.

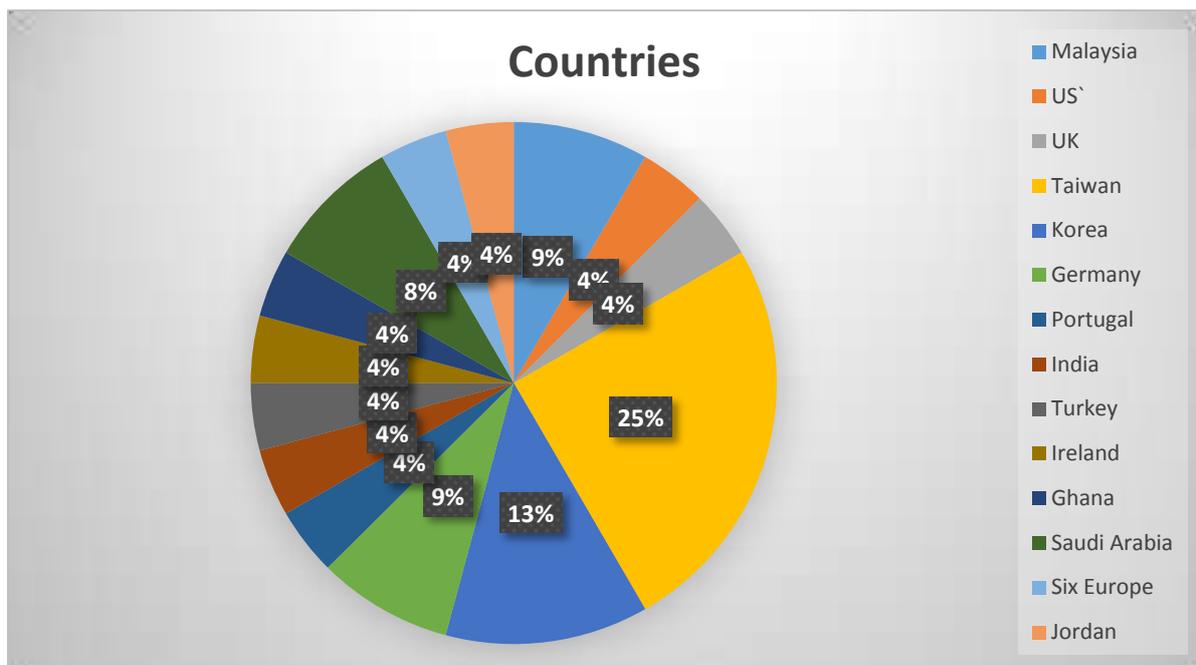


Fig. 5: Countries of the Studies

4.4 Sectors:

The studies have been conducted on various industries. The highest percentage among the reviewed articles was conducted on high tech (25%) followed by education (21%), several industry (17%), public organization (13%), hospital (8%), and service and manufacturing (4%).

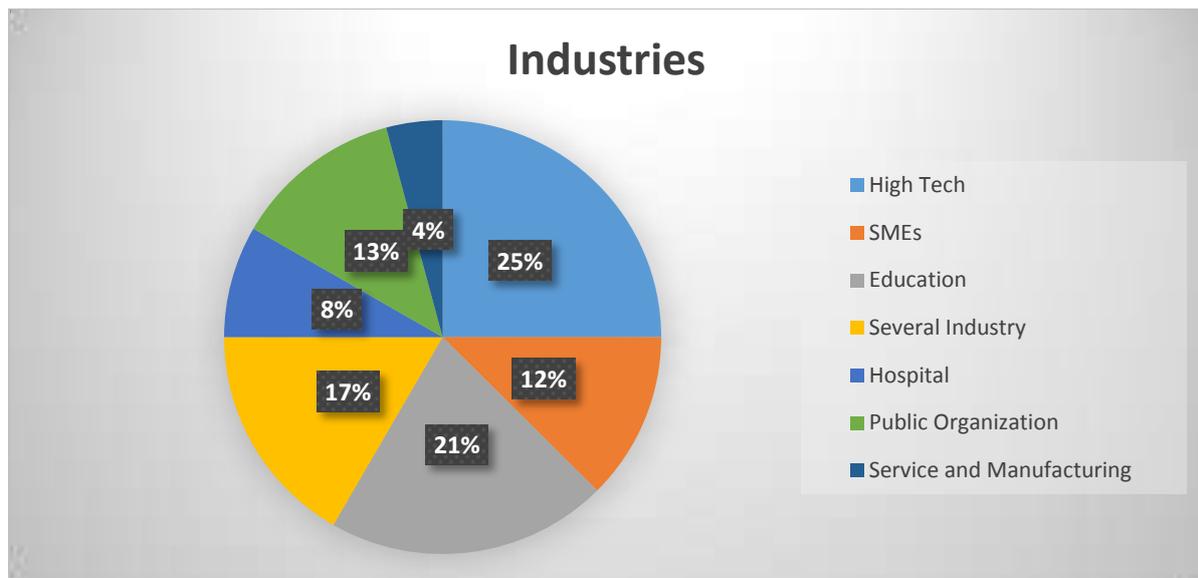


Fig. 6: Sector of the Studies

4.5 Methodological approach:

The quantitative studies outperformed the qualitative studies. A total of 81% of the reviewed studies are quantitative in nature followed by 15% are qualitative and 4% are mix method. Figure 7 shows the methodological approach of the studies.

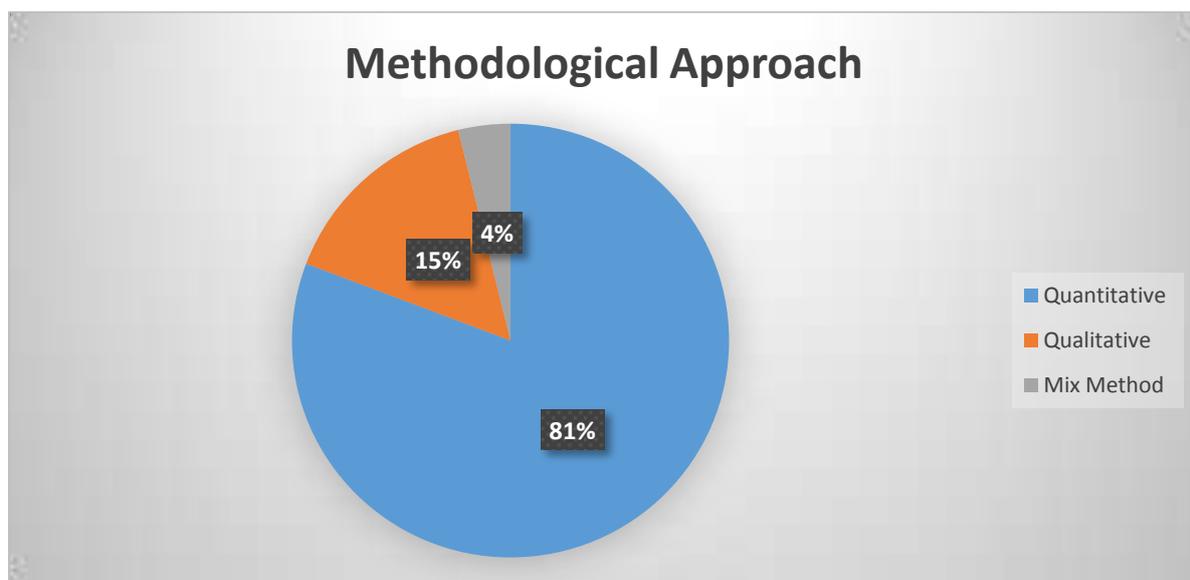


Fig. 7: Methodological Approach

4.6 Sample size:

The sample size of the 22 quantitative studies is presented in Figure 8. It shows that some studies have used a sample size as low as 30 respondents. The highest sample size is 1099 respondents. The mean of sample size in the studies is 247 respondents.

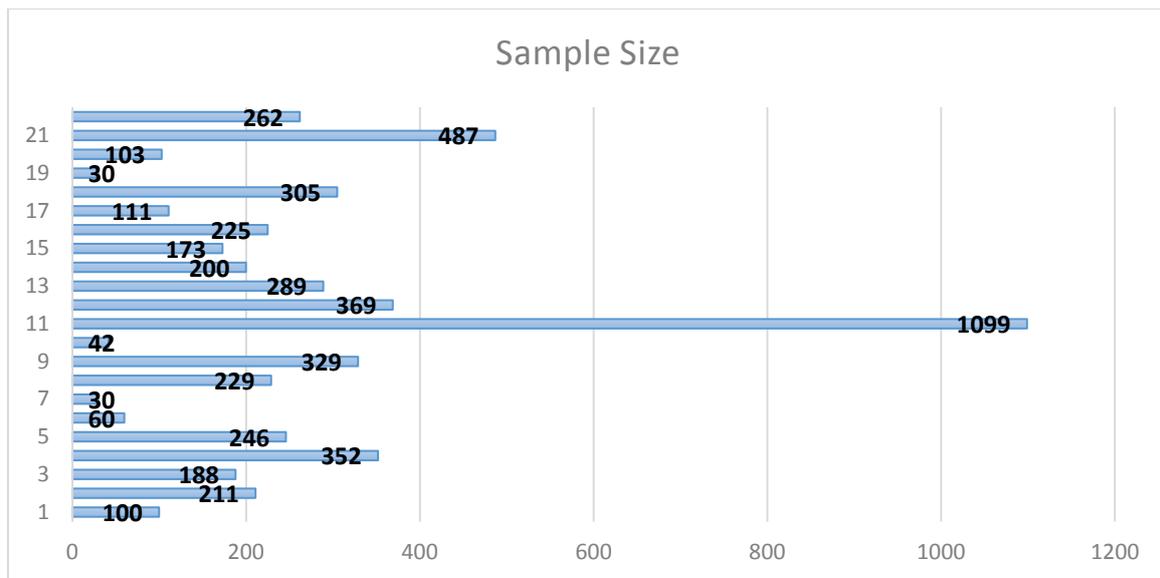


Fig. 8: Sample Size

4.7 Unit of analysis:

The respondents of the reviewed studies is given in Figure 9. It shows that 35% of the respondents are IT professional followed by 31% managers of companies. This is followed by 19% end users of cloud computing and 15% students.

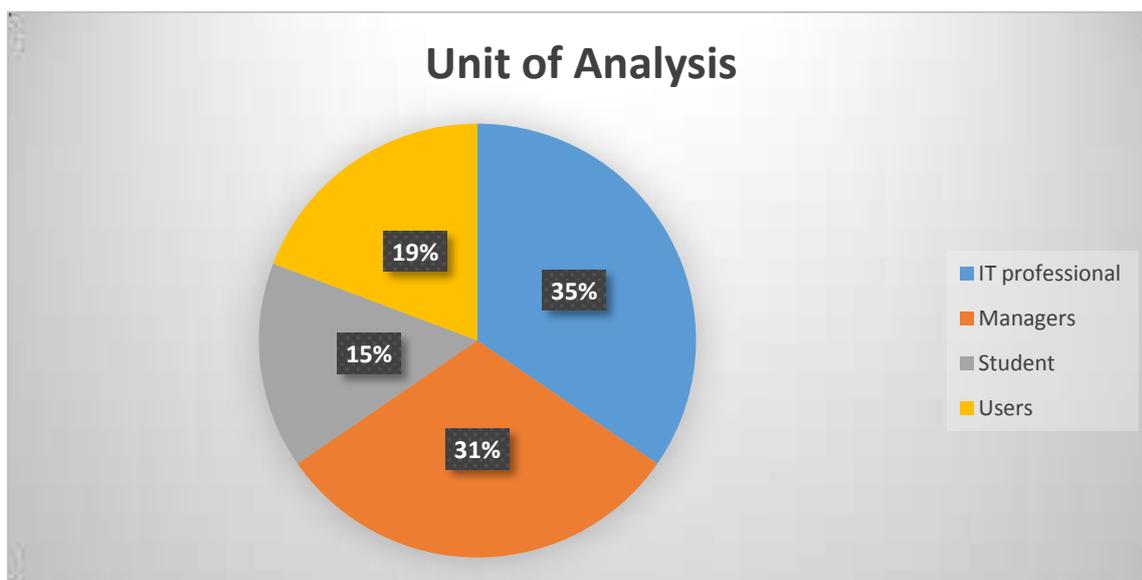


Fig. 9: Unit of Analysis

5. Limitation and Direction for future work:

We investigate the factors that affect the cloud computing adoption among business organization. Thus, our findings should not be generalized on other types of organizations. The findings of this study is limited to the articles that have been included in this study. Modification on the inclusion criteria of the article could result in different findings. The review articles only included empirical work between years 2011 and 2017. Expanding the period of research might lead to minor changes in the findings.

Future researchers are advised to conduct studies using variable such as security, complexity, computability, and relative advantage. This is because these variables were the most frequent in this study. They are also recommended to use theoretical model different from TAM. For example, UTAUT could better explain the variation in the cloud computing adoption. In addition, majority of the studies were conducted in developed and emerging economies such as Taiwan. Future researchers are recommended to conduct studies in developing countries especially the African countries because few of the studies conducted in this continent. High tech and

education were attracted the attention of researchers. However, financial institution such as banks and public organization have received less attention. Future researchers are recommended to examine the adoption of cloud computing in these organizations.

Majority of the studies are quantitative in nature. Future researchers are recommended to conduct mix method or qualitative studies. They are recommended also to use focus group approach where a group of expert mediated by the researchers can discuss the factors that affect the adoption of cloud computing. Future, minority of the researches combined two or more theoretical model. Future work are advised to combine UTAUT and TOE or UTAUT and DOI to better explain the variation in the cloud computing adoption.

Sample size of some studies are limited to 30 or 60 respondents. Future work are advised to expand the sample to include more respondent. A rule of thumb to use structural equation model requires a sample size more than 200 samples. Thus, future work are recommended to increase the sample size to this level. Users are the one who will use the cloud. Thus, future researchers are recommended to consider them the unit of analysis and collect the data from them.

Conclusion:

This study was conducted to identify the factors that affect the cloud computing adoption in business organization. Consequently, the study reviewed 27 articles that are pertaining to the topic of this research. A frequency analysis was conducted to extract the factors from the reviewed articles. Decision makers can benefit from this study because it shows that security is the most important variables followed by compatibility of the existing system, relative advantage, complexity of the cloud, privacy, ease of use and usefulness. Thus focusing on these variables could better explain the adoption. The TAM model still one of the widely used theoretical model in the context of cloud computing adoption. Majority of the studies was conducted in the emerging economies such as Taiwan and high tech industry has the largest share in the studies. The quantitative approach outperformed the qualitative and the sample size considered acceptable for most of the studies. IT professional was the unit analysis of majority of the studies. Future works are recommended to include security in their new models and they are recommended to combine two or more theoretical adoption model to increase the explanatory power of their models.

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