



Review Article

A Systematic Review of Cloud Computing Adoption by Organisations

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Abstract: Cloud computing represents a paradigm shift in information technology outsourcing. The technology renders numerous benefits such as flexibility, cost reduction and scalability. Also, it presents organisations with the opportunity to conform to environmental management system. Several studies have applied different theories to investigate the factors that affect cloud computing adoption by organisations. However, the results are inconclusive. Therefore, this study systematically reviews factors influencing adoption the adoption of cloud computing by organisations. A total of 174 papers were reviewed from different databases such as Science direct, Emerald and IEEE Xplore. Consequently, 37 of these articles have been considered to come up with the most salient factors based on their frequency. The findings indicated that technology readiness, top management support, relative advantage, competitive pressure, compatibility, complexity and data security are the significant factors that affect cloud computing adoption in organisations. This review consolidates literature and can benefit decision makers in organisations who intend to adopt cloud computing technology. Furthermore, it has laid a foundation for a future part of this work which is conceptualising a model for cloud computing adoption in the upstream oil and gas sector.

Keywords: Cloud Computing, Adoption, Factors Affecting Adoption, Technology Adoption Theories

1. Introduction

Cloud computing is a paradigm that allows organisations and users to utilise computing services via the internet on a pay as you use basis. It is considered as the technological revolution of the twenty-first century. The cloud offers several benefits such as scalability, flexibility and cost reduction. Several studies have used different technology adoption theories to carry out studies on cloud computing adoption by organisations. The technology organisation environment (TOE) framework by Tornatzky and Fleisher 1990 [1], Technology Acceptance Model (TAM) by David 1989 [2], Diffusion of innovation (DOI) by Rogers 1995 [3], and Unified theory of acceptance and use of technology (UTAUT) by Venkatesh 2003 [4] are the most applied theories to comprehend the factors that affect the adoption of cloud computing technology. However, there is no consensus on the theories or factors to explain adoption.

The aim of this study is to conduct a systematic literature

review of factors that affect cloud computing adoption. The first section of the paper introduces cloud computing adoption. The second section describes the methodology applied to conduct the review, the third section presents a comprehensive literature review, the findings and discussions of the study are presented in the fourth section, while the last section contains the conclusion and possible future works.

2. Methodology

This study reviews existing literature from different databases which include Science Direct, Emerald and IEEE Xplore to identify factors that affect cloud computing in an organisation. Keywords such as “factors affecting cloud computing adoption”, “cloud computing”, “cloud computing adoption in an organisation”, and a combination of these keywords have been used to identify related articles. Studies from 2011 to 2019 were considered for this study illustrated in Figure 1.

In total, 174 articles were found: 74 from Science Direct,

Emerald (58) and IEEE Xplore (44) and further refined through a screening process. Consequently, a total of 37 articles was considered for this study. Figure 2 summarises the articles refining process.

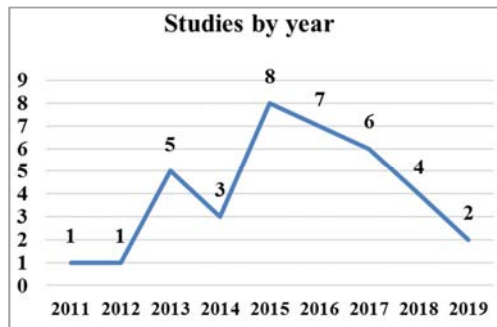


Figure 1. Studies by year.

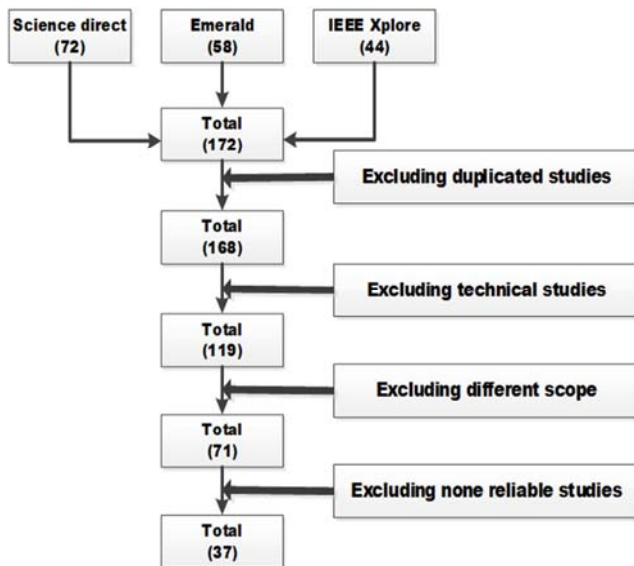


Figure 2. Article selection process.

3. Literature Review

3.1. Cloud Computing

The definition of cloud computing is diverse due to different opinions from engineers and academics with different interests. Most researchers, such as [5-7] agree that the technology is an evolving paradigm. The most widely used definition of cloud computing is one of the US National institute of standards and technology (NIST). According to NIST [8] “cloud computing is a model for enabling convenient, on-demand network access to a shared pool of 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”. The characteristics of cloud include on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service [8].

Cloud computing services can be delivered in three different models. Software as a service (SaaS) offers on demand pay per use of application software to users [9]. It runs an individual case of the software and makes it available for multiple end users. Platform as a service (PaaS) is mainly a development environment made up of an operating system, a programming language execution environment, a database and a web server [10]. While infrastructure as a service (IaaS) offers all the computing resources such as virtualisation, storage, networking and servers in a virtual environment for users to access [8].

There are four types of cloud deployment models; Public cloud is accessible to the public which could be either individuals or companies. In a private cloud, resources are dedicated to a single organisation. Hybrid cloud is a mixture of different types of clouds, typically a public and private clouds. A community cloud offers services to group of individuals or organisations sharing the same interest or working on joint projects [8].

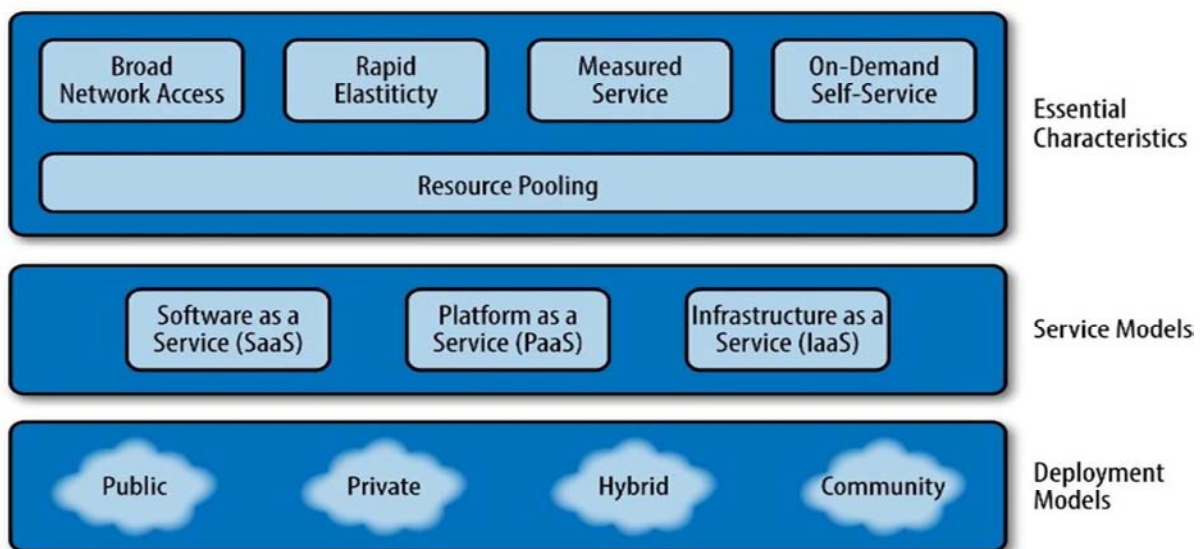


Figure 3. NIST cloud computing visual model.

3.2. Factors Affecting Cloud Computing Adoption

Several researchers have used different technology adoption theories to carry out studies on cloud computing adoption by organisations. These theories include Technology organisation environment framework (TOE), Technology adoption model (TAM), Diffusion of innovation (DOI), Iacovou, HOT-fit, Information system Triangle, Hofstede model, Fit-Viability model and Unified theory of acceptance and use of technology (UTAUT).

Reference [11] investigated the effect of nine (9) factors for cloud computing adoption on 111 high technology industries in Taiwan. The authors used the TOE framework to carry out the investigation. The findings showed that top management support, firm size, relative advantage, competitive pressure and trading partner pressure significantly influence adoption. Reference [12] applied the TAM model to investigate the influence of nine factors on the adoption of cloud services in information technology companies in Germany. The findings indicated that job relevance, image and perceived usefulness are the factors that affect the acceptance and use of cloud technology. Reference [13] investigated the factors affecting cloud technology adoption in Vietnam by integrating TOE framework and DOI theory. The findings revealed that technological complexity, relative advantage, organisation size, top management support, infrastructure availability, formalisation, trading partners' pressure and competitive pressure are the factors that affect adoption. This finding is identical to that of [11]. Reference [14] used the TOE framework to identify the critical organisational that influence the adoption of cloud computing in small and medium enterprises (SMEs). The study identified technology readiness, firm size and top management support as the organisational factors that should be considered before adoption. Reference [15] proposed a model to investigate factors that impact cloud adoption at organisational level, focusing on 24 global enterprises across various industries. Also, to know the impact of IT governance process and structures. The findings found three factors to positively impact adoption. The factors are competitive pressure, relative advantage and top management support. Reference [16] used the TOE framework to investigate the impact of factors on cloud computing adoption in high tech industries in Ireland. The findings revealed that all the factors in the TOE framework have significant effect on the adoption. Reference [17] used the TAM model to evaluate the impact of cloud adoption on SMEs in Malaysia. The findings identified cost reduction, privacy, security and ease of use as the factors that affect adoption.

Reference [18] assessed the impact of 11 cloud computing adoption factors on 369 manufacturing and service sectors in Portugal. Their study identified top management support, relative advantage, complexity, technological readiness and firm size as the significant factors to directly impact adoption in these organisations. Reference [19] examined the impact of factors on cloud adoption by government organisations, focusing specifically on Saudi Arabian government. The

authors integrated Iacovou et al., (1995) model and TOE framework to develop 19 hypotheses which were further tested. The findings indicated that cost, security, usefulness, quality of service, privacy, technology readiness, and organisation size significantly affect adoption. Also, trust, feasibility, government support, organisational structure, industry type, external pressure as well as direct and indirect benefits were found to influence adoption. Reference [20] integrated TOE and HOT-fit models to study the effect of 12 factors derived from the model on 60 hospitals in Taiwan. The findings revealed that cost, technical resource competence, data security, complexity and top management support are the critical factors influencing cloud computing adoption. In addition, security concern was found to be most influential factor, while technology context as the most critical followed by human, organisation and the environment, respectively. Reference [21] integrated the TAM model and TOE framework to identify the factors impacting the adoption of cloud services in different sectors in India, focusing on 280 companies. The findings showed that top management commitment, complexity, relative advantage, compatibility, organisational readiness, and training as the significant factors towards the adoption of cloud computing using perceived usefulness and perceived ease of use as mediating variables. Furthermore, trading partner support and competitive pressure directly affects adoption intention.

Reference [22] examined the effect of factors on managers' decision to adopt cloud services in the United Kingdom. The factors identified include technology readiness, complexity, competitive pressure and trading partner pressure. Reference [23] investigated the effect of factors on cloud technology adoption in Saudi Arabia. Factors found to be statistically significant include security, compatibility, top management support, firm size, organisation's readiness and government support. Also, security concern and government support were found to be more influential. Reference [24] assessed the factors influencing cloud technology adoption by organisations in Saudi Arabia. The authors integrated DOI and TOE framework to conduct the study. The findings revealed that trialability, trust, privacy, reliability compatibility, relative advantage and security are the technological factors that affect adoption. The organisational factors include technology readiness, organisation size and top management support, while the environmental factors are external support, physical location, regulatory compliance and culture. Reference [25] used the TOE framework to assess the influence of TOE factors on cloud adoption in public sector organisations in Germany, Greece, Italy, Poland and United Kingdom. The study revealed that compatibility, relative advantage and complexity are the significant technological factors. The organisational factors include transparency of processes, decrease in IT management, interoperability, environmental policies and security were identified as positive influencers for adoption. In addition, legal issues, bureaucracy and political matters, were identified to be influential under environmental context.

Reference [26] examined factors affecting adoption of cloud services in Saudi higher education institutions. The findings indicated that relative advantage positively affect cloud adoption. On the other hand, data concern and complexity negatively affect adoption. This is a confirmation that data concern and complexity are barriers to adoption. Complexity might be related to the lack of technical knowledge and skills for successful implementation.

Reference [27] used the technological and non-technological model to investigate the factors that affect cloud adoption on different government organisations in Iraq. The findings indicated that complexity, compatibility, relative advantage, IT knowledge and security influence adoption. Reference [28] integrated DOI and TOE framework to identify factors that influence cloud adoption in SMEs in India. The findings revealed that compatibility, complexity, interoperability, technical expertise, top management support, organisation size, trust, business requirement, physical location, government policies and competitive pressure influence adoption. Reference [29] investigated the impacts of TOE factors on cloud computing adoption in different Saudi Arabian organisations. The results revealed that only top management support affects adoption. Reference [30] used TOE framework to investigate the adoption of cloud computing in different Ghanaian industries. The study examined a total 10 hypothesis conceptualised in a model. The findings indicated that security concern, technology readiness, relative advantage, trading partner pressure, top management support and competitive pressure significantly affect adoption. Reference [31] investigated the key factors that influence the adoption of cloud computing in SMEs in Himachal Pradesh, India. The study was carried out using a survey on the SMEs and factor analysis was conducted. The study identified relative advantage, security, cost benefits, availability, reliability, technological risk, top management support and competitive pressure as the significant factors which affect adoption of cloud services in Indian SMEs. Reference [32] investigated the key factors and their level of influence on cloud technology adoption in Saudi Arabian overseas government organisations. The findings revealed that upfront cost, support from top management, trust and data security are the key factors that could influence adoption.

Reference [33] investigated factors influencing cloud computing adoption in Saudi Arabian healthcare organisations. The authors integrated the HOT-fit (Human–Organization–Technology) model, Information System Strategic Triangle (IS Triangle) and the TOE framework to evaluate the determinants of cloud computing adoption in healthcare sector. The findings revealed that factors in the business context (soft financial analysis and hard financial analysis) had the highest impacts on adoption. Followed by those in the technological context, then organisational. Environmental and organisational context were found to be less significant. Reference [34] integrated DOI theory and TAM model to examine the impact of technological, economic and contextual factors on cloud computing adoption in universities in

Sub-Saharan Africa. However, their findings did not show the effect of factors as the study only improved the model for further validation. Reference [35] investigated the influence of critical success factors on the adoption of cloud technology in oil and gas organisations in Oman. The author proposed a model by integrating DOI theory and TOE model to conduct the study. The findings indicated that only five out of the fourteen factors affect cloud services adoption. The factors include adequate telecom services, service providers' support, top management support, financial incentive and trialability. Strangely regulatory environment and data security were found to be not influential. Reference [36] investigated the significant influencing factors for cloud technology adoption in German SMEs. They integrated the TOE and DOI models to develop 10 hypotheses which were further examined on 16 SMEs in southern Germany. The results revealed that technological factors, particularly data privacy, data security and availability of broadband internet access significantly influence cloud adoption.

Reference [37] integrated TOE and Hofstede model which includes cultural factors to identify factors influencing the adoption of cloud computing by Universities in Saudi Arabia. The findings indicated that top management support, compatibility, relative advantage, readiness, competitive pressure, regulatory support, high individualism and high masculinity positively impact cloud computing adoption. Furthermore, high uncertainty avoidance, high power distance and data security were found to negatively impact adoption. Reference [38] integrated TOE and DOI to investigate factors affecting adoption in Saudi SMEs. The findings portrays that top management support, regulatory concern, relative advantage, complexity, infrastructure, ICT skills and competitive pressure significantly influence cloud adoption. Reference [39] used TOE framework to investigate factors that affect cloud computing adoption in various sectors in Malaysia. The results indicated that only IT resources significantly affect adoption. Reference [40] integrated Fit-Viability model and DOI to investigate factors influencing cloud adoption in government organisations in Yemen. The results indicated that adoption is influenced by trialability, relative advantage, data security, compatibility, return on investment and technology readiness. Reference [41] examined the factors impacting the adoption of cloud computing in healthcare services. Their study focused on 25 Sri Lankan private hospitals. The findings showed that all the factors in the technological, organisational and environmental contexts significantly impact cloud computing adoption in Sri Lankan private hospitals. Though the hypothesis were tested in the form of a context and not individual factors. Reference [42] examined the effect of TOE framework for cloud computing adoption in Egypt. The study identified telecommunication infrastructure and internet service providers as the critical factors impacting adoption.

Reference [43] used TOE to investigate factors influencing cloud computing adoption in SMEs in Malaysia. The results indicated that top management support, cost saving and technology readiness influence adoption. Reference [44]

investigated the factors influencing cloud computing adoption in Kenyan companies. The study conducted a survey on 283 software development companies. The findings revealed that top management support, right skills, worker attitudes (organisational factors), trading partner pressure, industry competition (environmental factors), compatibility, complexity, and perceived benefits (technological factors) are the factors influencing adoption. Furthermore, security concern was found to be the most critical factor that should be considered before adoption. Reference [45] examined the impact of some factors on cloud computing adoption in pharmaceutical companies in Jordan. The factors examined include relative advantage, complexity, compatibility, technology readiness, top management support, organisation size, trading partner pressure and competitive pressure. The results indicated that all the factors had a significant influence on cloud adoption. In

addition, the factors in the technological context were the most influential, followed by those in the environmental context and finally the organisational context. Reference [46] investigated the factors that influence cloud computing adoption in Indian secondary schools. The findings revealed that compatibility, complexity, relative advantage, top management support, attitude towards change, external expertise and competitive pressure have significant influence towards adoption. Reference [47] Used Unified theory of acceptance and use of technology (UTAUT) to investigate factors influencing cloud adoption in Nigerian health institutions. The findings showed that cloud knowledge, IT infrastructure and performance expectancy significantly influence the intention to accept and use cloud technology. Tables 1, 2 and 3 shows a summary of the reviewed studies. It indicates the authors, adoption theory, method and the unit of analysis.

Table 1. Studies on cloud computing adoption from 2011-2013.

Author(s)	Adoption Theory	Method	Unit of Analysis
Low et al. (2011)	TOE	Quantitative	IT Professionals
Opitz et al. (2012)	TAM	Quantitative	IT Professionals
Chang et al. (2013)	TOE and DOI	Qualitative	Managers and IT staffs
Militaru et al. (2013)	TOE	Qualitative	Managers
Borgman et al. (2013)	TOE	Quantitative	IT managers and decision makers
Conboy and Morgan (2013)	TOE	Quantitative	Managers
Gupta et al. (2013)	TAM	Quantitative	Managers

Table 2. Studies on cloud computing adoption from 2014-2016.

Author(s)	Adoption Theory	Method	Unit of Analysis
Oliveira et al. (2014)	TOE and DOI	Quantitative	Managers
Alsanea et al. (2014)	TOE and Iacovou	Quantitative	Staffs
Lian et al. (2014)	TOE and HOT-fit	Quantitative	IT Professionals
Gangwar et al. (2015)	TOE and TAM	Quantitative	Managers
Gutierrez et al. (2015)	TOE	Quantitative	Managers & IT staffs
Alhammadi et al. (2015)	TOE and DOI	Quantitative	IT Professionals
Alkhatir et al. (2015)	TOE and DOI	Quantitative	IT Professionals
Polyviou and Pouloudi (2015)	TOE	Qualitative	Public managers
Tashkandi and Al-Jabri (2015)	TOE	Quantitative	IT Professionals
Wahsh and Dhillon (2015)	Tech & non tech model	Quantitative	IT Professionals
Wilson et al. (2015)	TOE and DOI	Quantitative	CEOs and managers
Al-Jabri and Alabdulhadi (2016)	TOE	Quantitative	IT Professionals
Senyo et al. (2016)	TOE	Quantitative	IT Professionals
Kumar and Samalia (2016)	TOE	Quantitative	CEOs and managers
Albugmi et al. (2016)	TOE and DOI	Quantitative	IT and other staffs
Alharbi et al. (2016)	TOE, IS and HOT-fit	Quantitative	IT and health staffs
Sabi et al. (2016)	DOI and TAM	Quantitative	IS experts & lecturers
Al-Mascati and Al-Badi (2016)	TOE and DOI	Quantitative	IT managers

Table 3. Studies on cloud computing adoption from 2017-2018.

Author(s)	Adoption Theory	Method	Unit of Analysis
Deil and Brune (2017)	TOE and DOI	Qualitative	CEOs and IT staffs
Karim and Rampersad (2017)	TOE and Hofstede	Mixed	IT Professionals
Albar and Hoque (2017)	TOE and DOI	Quantitative	CEOs and IT managers
Hassan (2017)	TOE	Quantitative	Managers
Mohammed et al. (2017)	DOI & Fit-Viability	Quantitative	IT Staffs
Ayooobkhan and Asirvatham (2017)	TOE	Quantitative	IT Professionals
Kandil et al. (2018)	TOE	Quantitative	IT Professionals
Ming et al. (2018)	TOE	Quantitative	CEOs, IT & non-IT staffs
Mugunti and Opiyo (2018)	TOE	Mixed	IT managers
Al-Shura et al. (2018)	TOE	Quantitative	IT Professionals
Singh and Manstora (2019)	TOE	Quantitative	Staffs
Idoga et al. (2019)	UTAUT	Quantitative	Health Professionals

4. Findings and Discussion

A Frequency analysis was conducted on the reviewed articles for the findings of this study. The findings presented include the most important factors, theoretical model deployed, sector, method applied, and the region, respectively.

4.1. Factors Affecting the Adoption of Cloud Computing

Several factors have been used to study the adoption of cloud computing technology by organisations. Although, some factors are synonymous to others, e.g. Data concern as data security. However, factors have been counted based on their constant names as some scholars have used identical terminologies differently. For instance, perceived usefulness

and relative advantage have been used in a single study [22]. Hence, a frequency analysis was carried out to identify the most important factors based on how many times they appear. The results indicate that Top management support (22) and technology readiness (22) were highly frequent. Followed by relative advantage (20), competitive pressure (15), complexity (14), and compatibility (12), and security (11), organisation size and trading partner pressure with a frequency of nine each. Trust and privacy are among the important factors with a frequency of six each, reliability (5), cost benefit (5), followed by infrastructure cost, availability, government support, compliance with regulation, external support, workers' attitude, internet availability with four frequencies each. Others include Trialability (3) and culture (2). Figure 4 indicates the frequency of the factors.

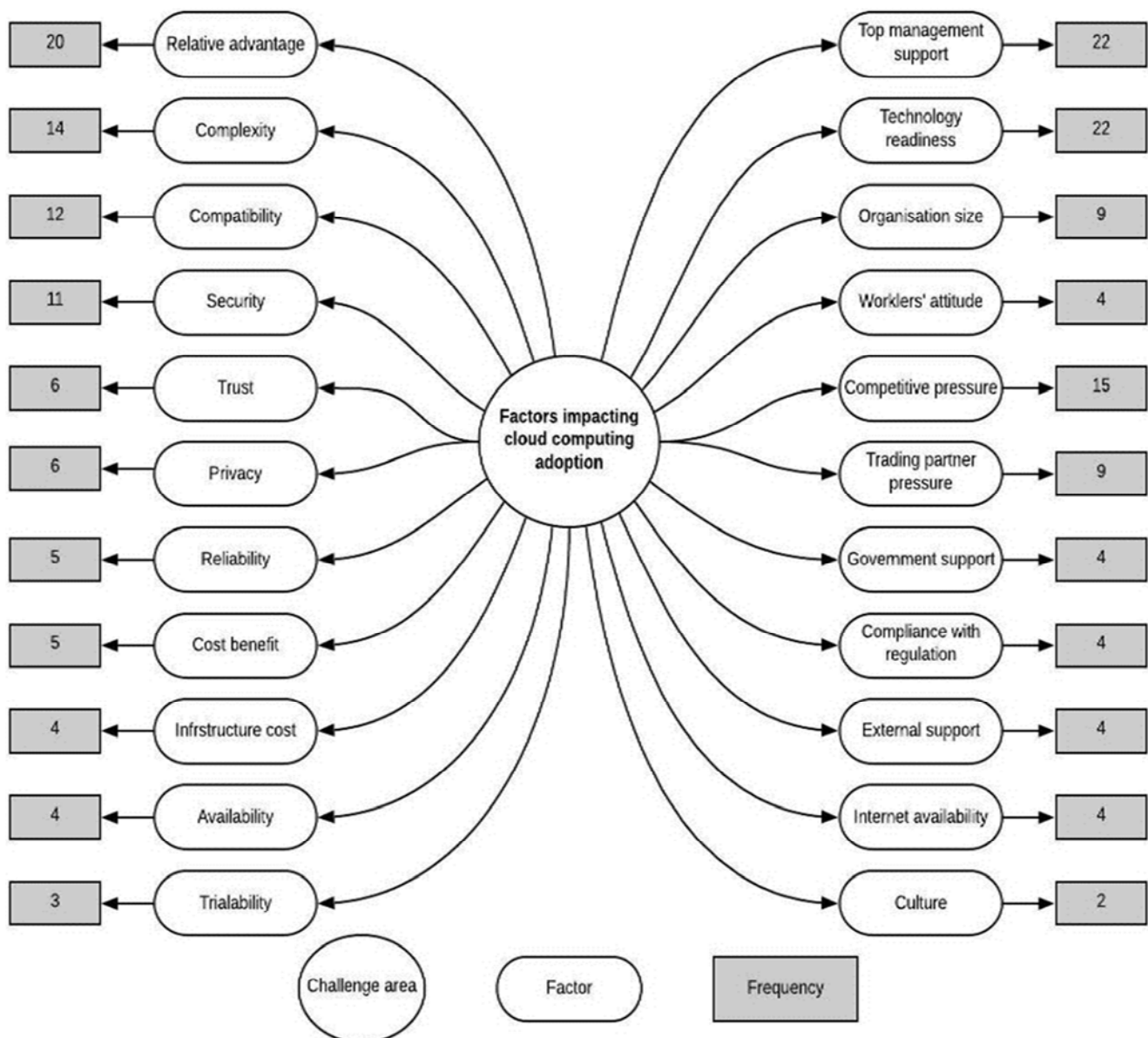


Figure 4. Frequency of factors in reviewed studies.

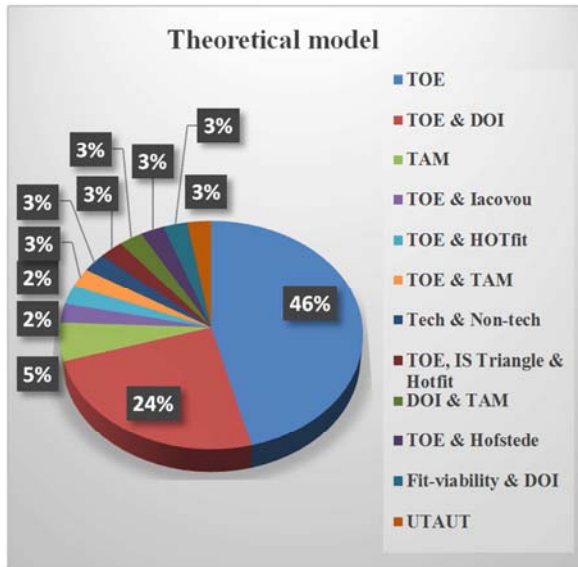


Figure 5. Theoretical models of technology adoption.

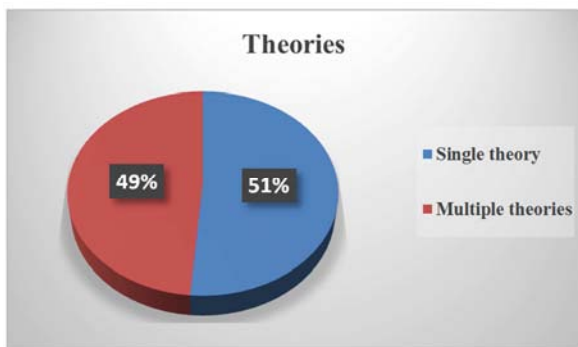


Figure 6. Theories of technology adoption.

4.2. Theoretical Model

The findings of the study showed that TOE (46%) was the most deployed model. Also, the framework was deployed alongside other models, nine times with DOI (24%), once each with TAM (3%), Iacovou (2%), HOT fit (2%), and Hofstede (3%). TOE was also merged with IS Triangle and HOT fit (3%). TAM was used alone in one of the reviewed studies (3%). DOI was deployed with TAM (3%), and Fit-viability model (3%) once each. Also, one of the studies deployed technological and non-technological model (3%). The UTAUT was used in one of the studies (3%). Figure 5 shows the theoretical models.

Furthermore, some studies have deployed a single theoretical model while others have used multiple models. Figure 6 indicates that 51% of the studies used a single theory while 49% have used multiple theories.

4.3. Sectors

The findings showed that 26% of the studies was conducted on SMEs, followed by different industries (14%), government/public (14%), healthcare (11%), high technology (6%), IT (6%), service and manufacturing (6%), and oil and gas (3%).

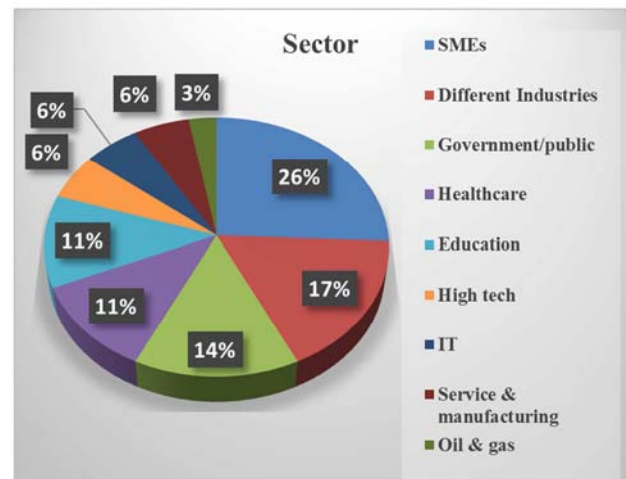


Figure 7. Sector of studies.

4.4. Region

The findings indicated that majority of the studies were conducted in the Middle East (38%), followed by Asia (29%), Europe (18%), and Africa (15%).

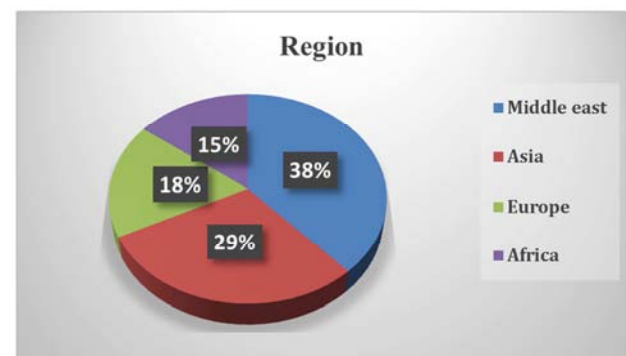


Figure 8. Region of studies.

4.5. Method

The findings showed that majority of the researchers have used the quantitative method in their studies, 81% of the reviewed articles applied this method. Followed by the qualitative (14%). Only 5% of the studies used mixed method.

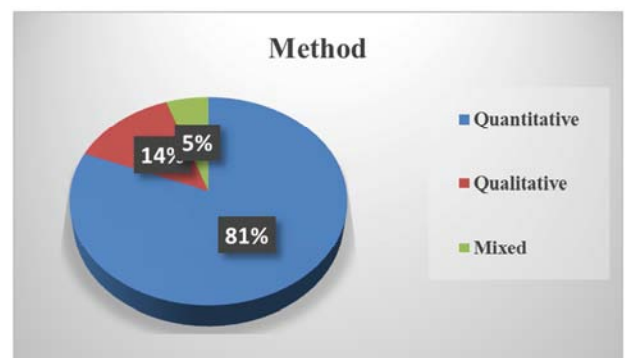


Figure 9. Method applied.

Obviously, Literature has focused on cloud computing

adoption in general and in different sectors. This review study has helped in identifying factors that influence cloud adoption in organisations. However, an empirical investigation of factors that influence the adoption of cloud computing in the context of the upstream oil and gas industry is yet to be addressed. The adoption of cloud technology in the industry has been accompanied by some challenges, therefore, relevant industry-specific factors that influence

adoption decision also need to be explored and analysed [48]. A future part of this work will focus on conceptualising a model for cloud computing adoption in the upstream oil and gas industry. Subsequently, the model shall be modified and validated. Figure 10 illustrates a summary of studies on factors affecting cloud computing adoption in various sectors.

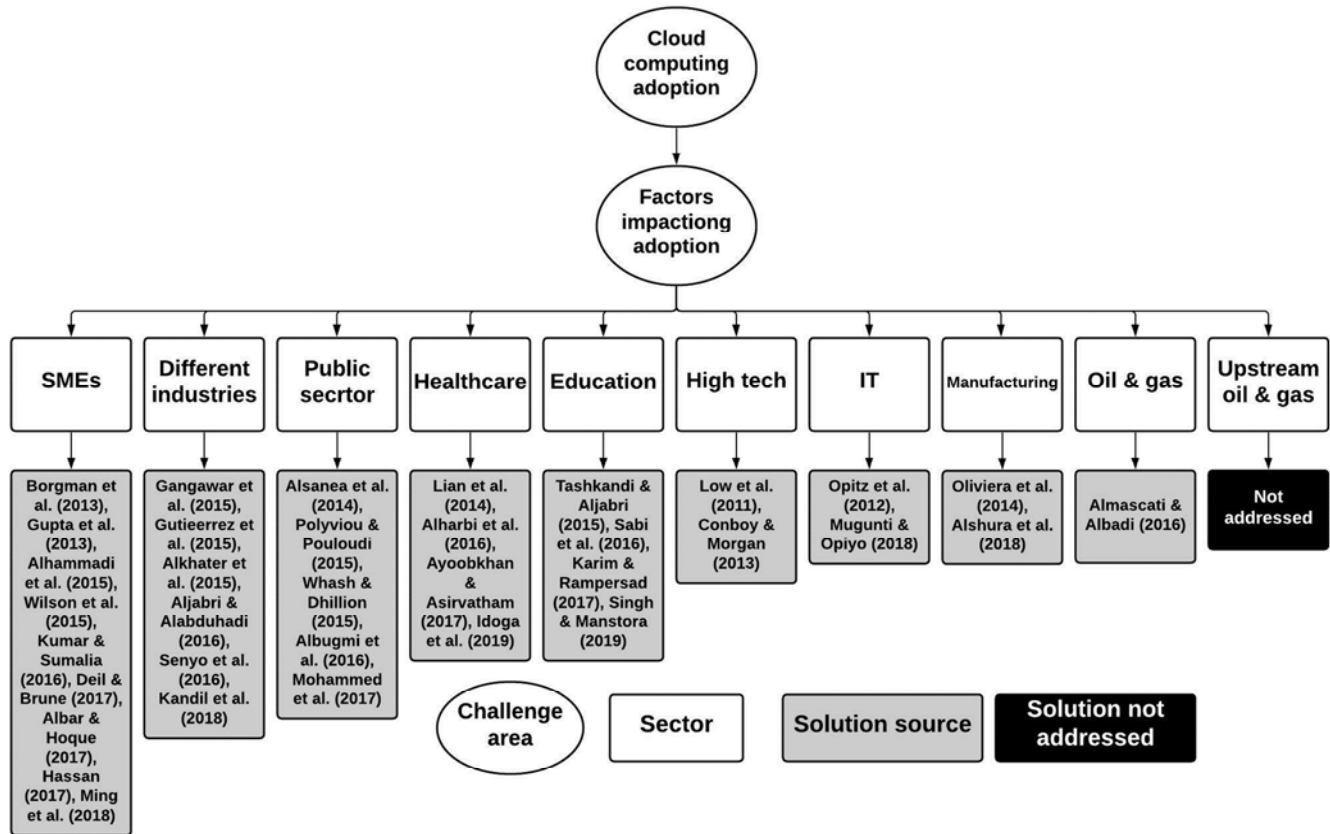


Figure 10. Summary of studies on factors affecting cloud adoption in different sectors.

5. Conclusion and Future Works

This study reviews factors that affect cloud computing in organisations. A total of 37 articles were reviewed. Consequently, a frequency analysis has been carried out to identify the most important factors. The factors include technology readiness, top management support, complexity, relative advantage, competitive pressure, compatibility and data security. The study can benefit decision makers in organisations who might consider adopting cloud computing. Majority of the studies have deployed the TOE framework. Quantitative approach was the most applied compared to qualitative. Also, most of the studies were conducted on SMEs.

Finally, it is recommended that future studies are conducted using variables such as technology readiness, top management support, complexity, relative advantage, competitive pressure, compatibility, and data security as they are the most frequent factors. In addition, future

works on factors affecting cloud computing adoption are advised to combine theoretical models such as UTAUT, DOI and TAM to better explain the variation. Moreover, future studies should focus on more sophisticated organisations such as upstream Oil and gas, automobile etc.

The upstream oil and gas industry which identifies and produces oil and natural gas has a fragmented pattern of activities [48]. This is due to remoteness of oil and gas exploration fields and the need for centralized decision making. Consequently, this raises an alarm for a sustainable technology solution. Cloud computing technology is flexible, scalable and affordable. However, the technology has not fully penetrated the upstream oil and gas sector due to some challenges most notably data security [48]. Therefore, there is need to explore and analyze all the critical success factors that might affect cloud adoption in the sector in order to guide successful adoption. Thus, an ongoing research is in progress to achieve this aim.

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