Review Article

Adoption of Cloud Computing in E-Government: A Systematic Literature Review

Osama Abied[1]*, Othman Ibrahim[1] and Siti Nuur-Ila Mat Kamal[2]

[1]*Department of Information Systems, Azman Hashim International Business School, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia*
[2]*Faculty of Information Management, Universiti Teknologi MARA, Jalan Universiti Off KM 12 Jalan Muar, 85000 Segamat, Johor*

ABSTRACT

Cloud computing in governments has become an attraction to help enhance service delivery. Improving service delivery, productivity, transparency, and reducing costs necessitates governments to use cloud services. Since the publication of a review paper on cloud adoption elements in e-governments in 2015, cloud computing in governments has evolved into discussions of cloud service adoption factors. This paper concentrates on the adoption of cloud computing in governments, the benefits, models, and methodologies utilized, and the analysis techniques. Studies from 2010 up to 2020 have been investigated for this paper. This study has critically peer-reviewed articles that concentrate on cloud computing for electronic governments (e-Governments). It exhibits a systematic evaluation of the empirical studies focusing on cloud adoption studies in e-governments. This review work further categorizes the articles and exhibits novel research opportunities from the themes and unexhausted areas of these articles. From the reviewed articles, it has been observed that most of the articles have employed the quantitative approach, with few utilizing qualitative and mixed-method approaches. The results reveal that cloud computing adoption could help solve problems in learning, such as infrastructure issues, cost issues, and improve service delivery and transparency. This review gives more information on the future directions and areas that need attention, like the trust of cloud computing in e-governments.

Keywords: Adoption, cloud computing, cloud services, e-government

INTRODUCTION

As Information Technology innovation is advancing (Sallehudin et al., 2020), cloud computing in governments is helping improve productivity (Ali et al., 2018b) while enhancing efficiency, transparency, and public service delivery (Mohammed et al., 2016; Nanos et al., 2019). Furthermore, since the evolution of cloud computing in the 2000s (Bayramusta & Nasir, 2016; Senyo et al., 2018), there have been developments in the automation of existing procedures, making infrastructure, software, and platforms easily available on-demand for pay (Sharma et al., 2020). Recently, cloud computing has become a strategic direction for e-governments around the globe because of its benefit in overcoming infrastructure issues as well as attaining cost reduction (Mohammed et al., 2020; Singh et al., 2020).

Cloud computing has also attracted several studies (Senyo et al., 2018). There is no doubt that various large governmental organizations are using cloud computing differently. Apart from becoming popular, it has become a powerful driver for economic and technological changes worldwide (Vu et al., 2020). For instance, in healthcare predictions (Anuradha et al., 2021; Tuli et al., 2020), in smart cities (Wang et al., 2020), in small and medium enterprises (Alismaili et al., 2020), in governments (Zhang, 2020), and education (Vaidya et al., 2020), among other fields. Moreover, the utilization of cloud computing has yielded unprecedented opportunities for organizations to improve their performance. Besides this, the unique properties of cloud computing have made modern governments transparent, efficient, effective in response, and creative (Al Mudawi et al., 2019; Ali et al., 2018a; Nanos et al., 2019).

Hence, with this trend, utilizing cloud computing will create convenience, improve accessibility and quality of delivery of government services, and improve the flow of information and procedures. It will further improve the speed, coordination, and enforcement of activities in the public sector. This paper focuses on existing literature on cloud computing as a supporting technology for e-governments and brings out the themes, methodologies, trends, critical factors, theories, and data analysis techniques in past studies. This paper will critically evaluate existing works and studies on cloud computing in e-governments and highlight new research areas. Three research questions have been developed as explained subsequently to guide this study. The systematic review is complementary to the past studies and gives the following contributions for the researchers interested in cloud computing and e-governments to further their studies. The following research questions will guide this study:

RQ1. What is the research area in focus in cloud computing on e-governments?
RQ2. How is cloud computing used to improve service delivery in e-governments (benefits)?

RQ3. What themes, factors, methods, level of implementation, data analysis techniques, and methodologies are available, and what is the gap for cloud computing in e-governments?

The research identifies primary studies related to cloud computing in e-governments from 2010 to 2020. Other researchers can utilize this list to further their work. The research further selects studies that meet the criteria set for quality assessment. These studies are a good ground for comparing similar works. Comprehensively, this study analyzes the articles and brings out the ideas, themes, methods, methodologies, level of implementation, and factors in the field of cloud computing and e-governments. Finally, a discussion is presented on how to further this work.

This paper is outlined as follows: Section 3 examines the methods used in this study and the primary studies that were systematically chosen for evaluation. Section 4 discusses the findings from the primary studies. Section 5 carries out a discussion as highlighted in the research questions. Lastly, section 6 presents the conclusion and suggestions for further research.

PRIOR RESEARCH

Specifically, and to the best of the researchers' knowledge during this research, the systematic literature reviews (SLRs) concerning the application of cloud computing in e-governments are still limited in number. One of the most recent surveys was on the effect of cloud computing on the sustainability of government services (Mohammed et al., 2020). In this study, the authors identify the gap in incorporating cloud computing as a platform for establishing sustainable services. In the view of this study, the researchers give an important starting point to fellow researchers interested in cloud computing in e-governments. Apart from this, several studies about cloud computing and its extensive use have also been published, and this study will examine them consecutively to extract their differences in the themes chosen by the authors and this research.

A systematic review was done on cloud computing and e-governments (Tsaravas & Themistocleous, 2011). The study highlights the application of Service-Oriented Architecture in e-governments and the utilization of cloud computing in the public sector. In addition, the study highlights the benefits and obstacles of cloud computing, the service models used in cloud computing, and the deployment models. The study also examines the case studies in the cloud in e-governments. However, the study excludes the models, methodologies, level of implementation, themes, and critical factors and focuses mostly on the government organizations in some cities that have adopted cloud computing solutions for improved service delivery.

In 2015, a review was conducted on models of adopting cloud computing in an e-government context (Mohammed & Ibrahim, 2015a). Interestingly the paper highlights the benefits and challenges of cloud computing in e-government structures and examines the proposed cloud computing adoption models. Furthermore, it classifies the models into various categories, such as "layered-based," "step-based," "component-based," and "conceptual/theoretical" models. Since 2016 the application and adoption of cloud computing have grown, and as such, our research seeks to bring out the themes, methodologies, level of implementation, data analysis techniques, and critical factors that have been examined.

A systematic review was also conducted on factors affecting the adoption of cloud computing in e-governments (Wahsh & Dhillon, 2015b). The paper concentrates on the factors affecting cloud adoption in e-governments for public sectors, and this research covers a timeline of up to 2015. The paper suggests an extension of research to include theoretical models. Therefore, our research will seek to highlight the models and factors that have been brought out till 2020. The themes, the level of implementation, methodologies, and data analysis techniques will also be highlighted.

All the past studies mentioned above highlight the wider use of cloud computing; however, they leave out some elements like the methodologies, the level of implementation, data analysis techniques, the factors, and themes used for better adoption solutions. Furthermore, the field of cloud computing in e-governments is growing relatively fast. Hence, it is of significance to provide a summary of the upcoming research studies, more so in cloud computing in e-governments, to act as a guideline for new research studies.

RESEARCH METHODOLOGY

This study conducted a systematic review with the guidance of Kitchenham and Charters (Kitchenham & Charters, 2007) to answer the research questions. The study goes through the planning, execution, and reporting stages of the review while revisiting them back and forth for a thorough examination of the systematic review.

Choosing Primary Studies

The primary studies were selected based on keywords via the search engine or search facility of the journal. The platforms under investigation included IEEE Xplore digital library, Wiley Online, Library, SpringerLink, Google Scholar, ScienceDirect, ACM Digital Library, and Scopus. The exploration was done using the keywords, title, or abstract grounded on each specific platform. The keywords were chosen to enhance the appearance of the study results that would help answer the research questions. The Boolean operators "AND" and "OR" were used where relevant. The search strings used were: ("cloud computing" OR "cloud-computing" OR "cloud service" OR "cloud adoption" OR "cloud implementation") AND

("e-government"), and ("cloud computing" OR "cloud-computing" OR "cloud service" OR "cloud adoption" OR "cloud implementation") AND ("public service" OR "public sector" OR "public service delivery").

The investigation included any study published from 2010 up to 2020 December. The outcomes were filtered via the inclusion/exclusion measures as presented. The measures enabled the production of outcomes that underwent snowballing from the explanation given (Wohlin, 2014). This study conducted backward and forward snowballing until the inclusion measures were attained.

Inclusion and Exclusion Measures

This section describes the inclusion and exclusion measures considered while filtering the study search results for this research. Any literature chosen for this SLR must have given empirical outcomes and should have carried out the study via case research, new technical cloud computing utilization, and commentaries on establishing e-governments through cloud service applications. The research articles should have been peer-reviewed and documented in English. The outcomes from Google Scholar were scrutinized for compliance with the measures as chances could arise for Google Scholar to furnish papers, which are graded lower. The current researched versions were also included in this study. The inclusion and exclusion measures are detailed in Table 1.

Table 1

Inclusion and exclusion criteria

The article must have details linked to cloud computing or associated with cloud service technologies in e-government	Articles concentrating on the impact of cloud computing in e-government or public sector
The article must present empirical data linked with the adoption and application of cloud computing in e-government	Grey information like blogs and government documents
The article must be in English, peer-reviewed, and published in a journal or conference proceeding from 2010 to 2020	Non-English articles, outside the year range

Selection Outcomes

There were up to 654 studies identified from the initial keyword search on the selected platforms. It was reduced further using the inclusion and exclusion criteria and after removing a lot of duplicate studies. The number of papers that were read in full was 94 papers. The 94 articles were then fully read using the inclusion and exclusion criteria, and

20 papers remained. Applying forward and backward snowballing established eight papers, giving an ultimate figure of 28 papers to be included in this SLR.

Quality Assessment

Evaluation of the quality of the primary research articles was undertaken by following the direction of Kitchenham and Charters (Kitchenham & Charters, 2007). Accordingly, the evaluation was done to extract the relevant articles connected to the research inquiries without any biases and with the validity of the empirical data. The evaluation procedure is grounded on previous research by Hosseini et al. (2017). Five randomly chosen articles were put through the quality evaluation procedure to examine their efficiency. The procedure is as follows:

Step 1: Cloud computing. The article must concentrate on adopting cloud computing or the application of cloud service to a specific, well-mentioned issue.

Step 2: Context. The required context must be given for the study's aim and outcomes. It permits good result interpretation.

Step 3: Cloud computing application. The article must possess the right information for a perfect exhibition concerning the utilization of innovation for a particular problem. It aims to answer RQ1 and RQ2.

Step 4: E-government context. The article must furnish information about the e-government problem to attempt and answer RQ3.

Step 5: Cloud computing performance. It seeks to evaluate cloud service performance in e-government. It will help bring benefits for cloud services.

Step 6: Data gathering. Information about models/frameworks, data collection, measurement, and presentation must be included for precision.

The checklist mentioned above for quality estimation was utilized for every other primary article chosen.

Data Extraction

Every paper that successfully went through quality evaluation underwent data extraction to examine the fullness of data to validate the accuracy of the details gathered in the articles. Data extraction was first done on the first five articles before expansion to incorporate all the articles that successfully underwent the quality evaluation stage. Then, extraction, grouping, and caching of the information were done using excel spreadsheets. The groupings entailed: context details or theme (detailing purpose of the study), methodology (qualitative or quantitative data), level of implementation (organizational or individual), factors (significant elements for adoption), framework or model (information system

models), and data analysis methods (PLS/SEM). Figure 1 exhibits the articles chosen at every phase of the procedure and the rate of every article selected from the keywords utilized in the search to the ultimate choice of the primary articles.

ANALYSIS AND FINDINGS

The details were compiled within the qualitative and quantitative data groups to answer the research questions. The study also did a meta-analysis of the articles that went to the final extraction procedure. The results are subsequently discussed.

Publication Rate

The concept of cloud computing was started as early as 1961 by John McCarthy, but its usage by organizations only began in 2009 (Attaran & Woods, 2018). Hence, this study finds no final primary studies with empirical results published before 2015. It shows that the idea is not fully saturated for e-governments. Figure 2 shows the number of primary studies published every year.
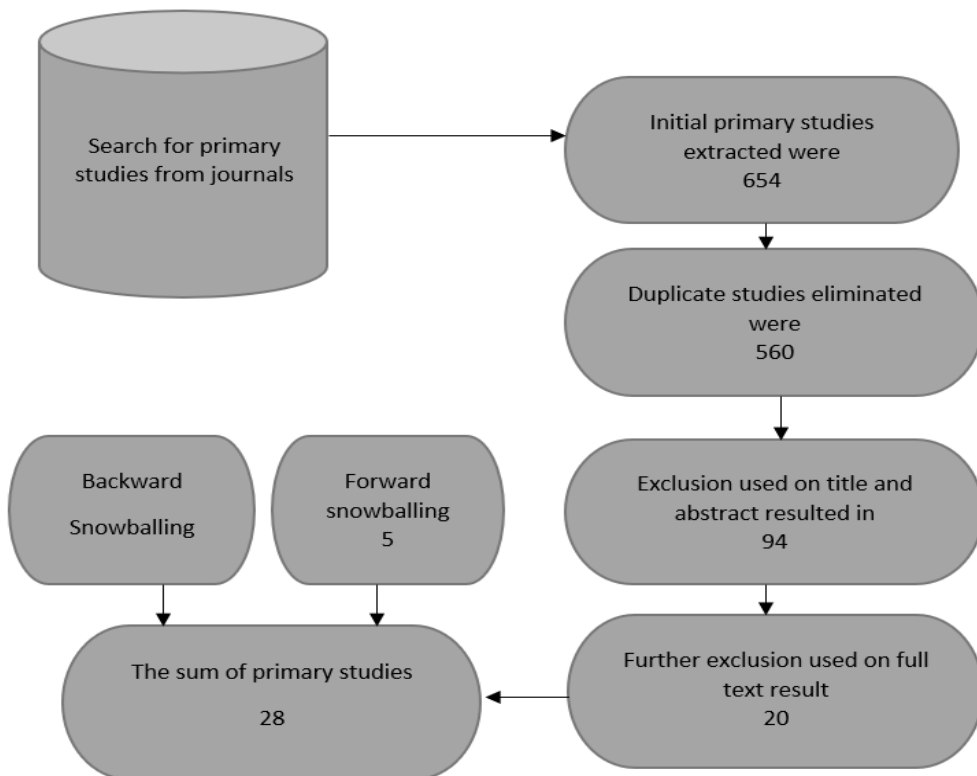

Figure 1. Extraction of the articles through the process

As can be seen from Figure 2, the trend is not consistent, but there were more publications in 2017 compared to all the other years. This study forecasts that there are still many studies coming up on cloud computing in e-governments. The number of publications in 2019 was very low compared to the other years.
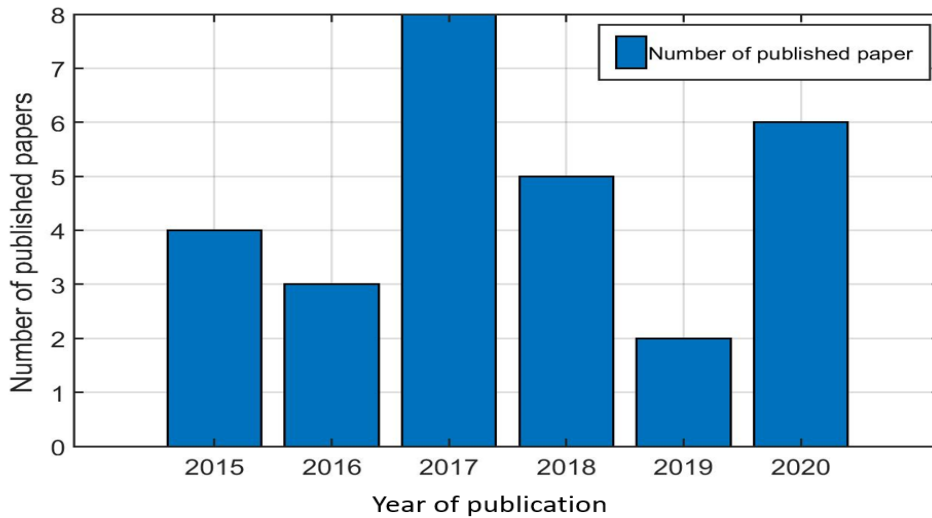

Figure 2. Primary studies published overtime

However, from Figure 2, 2020 has shown an upward trend in the usage of cloud services in e-governments compared to 2019, which received only a few studies. Information and communication technologies still play a role in good governance and public service delivery; hence, the researchers anticipate seeing more studies as years go by.

The Effect of Keyword Counts

To summarize the common themes in the chosen primary studies, 28 articles were analyzed. Figure 3 shows the word cloud from the 28 studies utilized in this paper.

Furthermore, Table 2 exhibits the number of times specific words were seen in the primary studies.

The analysis of keywords was performed across all the 28 primary studies to summarize the common themes in the primary studies. Table 2 exhibits the number of times specific words appeared in all the primary articles. From Table 2, excluding the keywords that were chosen for this study, which were "cloud computing" and "e-government," the third keyword that appears most frequently is "adoption," followed by "information," and then "model." It shows an interesting trend in the adoption of cloud computing. Adoption is the

Figure 3. Shows the word cloud

Table 2

Word count for the primary studies

Word	Length	Count	Weighted Percentage
cloud	5	4128	2.45%
government	10	2399	1.42%
adoption	8	2076	1.23%
computing	9	2034	1.21%
information	11	1313	0.78%
technology	10	1085	0.64%
services	8	863	0.51%
public	6	850	0.50%
study	5	816	0.48%
factors	7	804	0.48%
research	8	782	0.46%
model	5	779	0.46%
management	10	769	0.46%
journal	7	622	0.37%
service	7	605	0.36%
systems	7	558	0.33%
based	5	536	0.32%
innovation	10	524	0.31%
perceived	9	479	0.28%
security	8	461	0.27%

Table 2 *(Continue)*

Word	Length	Count	Weighted Percentage
organization	12	458	0.27%
decision	8	417	0.25%
international	13	412	0.24%
trust	5	403	0.24%
using	5	391	0.23%
business	8	379	0.22%
organizational	14	372	0.22%
system	6	350	0.21%
results	7	331	0.20%
organizations	13	330	0.20%
value	5	328	0.19%
support	7	322	0.19%
intention	9	319	0.19%
adopt	5	316	0.19%
theory	6	302	0.18%
users	5	302	0.18%
table	5	298	0.18%
effect	6	297	0.18%
studies	7	293	0.17%
influence	9	292	0.17%
sector	6	286	0.17%
technological	13	286	0.17%
analysis	8	279	0.17%
acceptance	10	274	0.16%
usage	5	271	0.16%
resources	9	267	0.16%
significant	11	266	0.16%
implementation	14	260	0.15%
process	7	258	0.15%
important	9	256	0.15%

word mentioned most, and in relation to Figure 2, more adoption studies were conducted in 2018. A fluctuation of studies conducted yearly has been observed. Moreover, 2020 has seen a tremendous rise in the adoption of cloud services. Adoption is further highlighted in the discussion section.

Every primary article extracted was read in full, and the qualitative and quantitative details were captured, along with the data analysis technique used, the themes, factors, and the respondents for the study (Appendix A).

All the studies focused on the adoption or usage and factors for the adoption of cloud computing in e-governments. Moreover, some studies mentioned the benefits of the cloud in e-governments, the cloud service models that can be used, as well as the deployment models. Few studies also highlighted the barriers to cloud adoption. Within the extracted papers, some authors also highlighted the benefits of cloud computing in e-governments. This study also extracted the methodologies that every paper has adopted. Figure 3 shows the distribution of the methodologies adopted by the different studies.
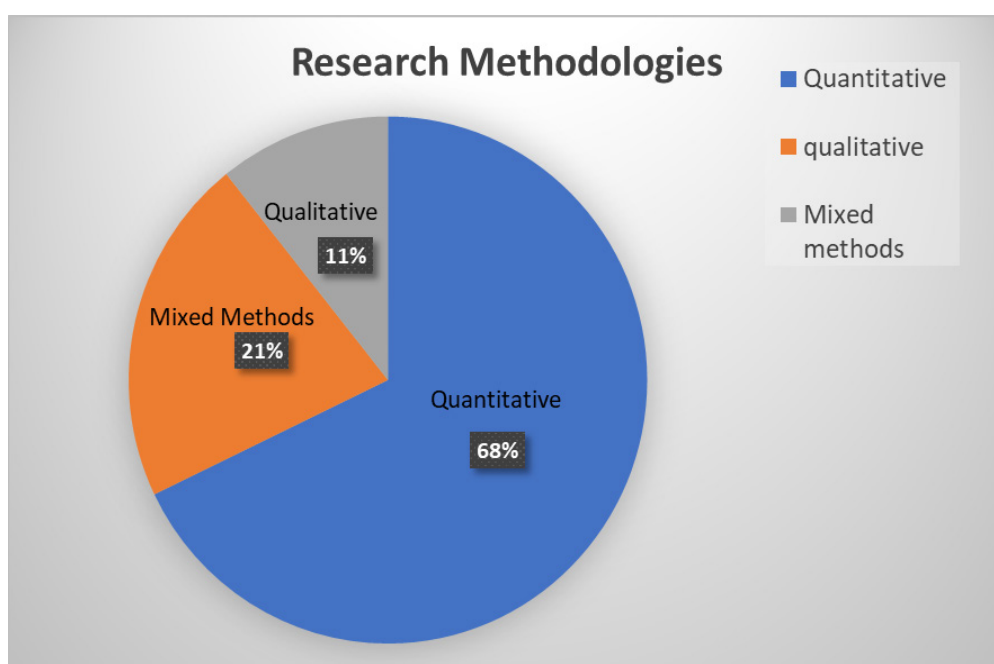

Figure 4. Research methodologies used in the primary studies

According to Figure 2, most studies have used the quantitative method, while very few studies have adopted the mixed method. The information was extracted from the primary studies, and it details the methods used, as shown in Appendix A. While most studies have highlighted the factors for the adoption of cloud computing with models/theories, this

research still highlights that TOE is the most used model for studying cloud adoption in e-governments (13 studies), while DOI (12 studies) follows closely (Appendix A). TOE is a model established to examine technology adoption at the organizational level (Tornatzky et al., 1990). Accordingly, most studies use TOE to study adoption behavior and a holistic approach (Al Hadwer et al., 2021; Alkhalil et al., 2017; Awa et al., 2017). For governments to deliver online services, TOE is appropriate as it helps to investigate the adoption factors for cloud computing in governments (Hsu et al., 2014). It is also a holistic instrument for organization-level studies.

Similarly, DOI has been used by most studies for the adoption and diffusion of innovations, as shown in this study (Appendix A). According to Rogers, this theory can predict the decisions of people in the adoption of new technologies through the examination of patterns and structure (Rogers, 2010). The theory examines adoption through the features of innovation. Furthermore, the model points to the need for exposure to the innovation when the adoption process begins. DOI explains the mechanism of adoption and can predict if a new invention will succeed through the attributes of that innovation (Mohammed et al., 2017a). Most studies have not used the HOT fit model for assessing the human factors in the adoption of cloud computing. Only one study incorporated HOT fit to study the acceptance of cloud in public services. The HOT model highlights the impact of human and organizational elements (Yusof et al., 2008). Accordingly, aligning organization, technology, and humans are significant, as it is a starting point in IT implementation and investment.

Furthermore, the study argues that organizations need to prepare their staff to adopt innovations or any organizational changes (Setiorini et al., 2021). HOT is flexible and fits various fields, stakeholders' perspectives and evaluation systems' life cycles (Yadegaridehkordi et al., 2020). Other researchers have found minimal utilization of HOT (Sallehudin et al., 2019; Sharma et al., 2020). Nevertheless, some studies have merged HOT with other models to study adoption (Alharbi et al., 2016; Lynn et al., 2020). This research found a few studies (6 studies) that have concentrated on individual elements for the adoption of cloud computing. It shows the need to look at the human element in adoption studies. Human employees, for instance, play a great role in internal issues or opportunities related to information technology.

DISCUSSION

The initial keyword searches exhibited that several papers are related to cloud computing. Organizations have adopted cloud computing since 2009; however, it has not yet reached maturity. Most of the papers have highlighted the factors for consideration while bringing the benefits of the technology to governments. The extracted papers have employed different models to extract elements that decision-makers can consider in governments before adopting cloud services.

The studies also highlight how issues like privacy, security, data, infrastructure, cost, and performance can be solved by using cloud computing. It depends on the government's choice to adopt cloud computing. Infrastructure issues can be solved as cloud computing offers reduced costs on the infrastructure acquired and used with remote accessibility. For instance, a study mentions that cloud computing SaaS can improve IT infrastructure costs with fewer management concerns (Hadi & Omar, 2021).

Cloud computing has been highlighted to provide almost readily available hardware that requires no prior capital (Avram, 2014). Besides, several promising upcoming start-ups like Jungle Disk, Gigavox, SmugMug became possible with investments in information technology with a lesser order of magnitude. As such, a cloud service is an adaptive infrastructure that is possible to be shared by various clients, utilizing it in different ways. The flexibility of the infrastructure permits the balancing of computing loads even with many users joining the system. It is an expansion in economies of scale.

RQ1: What is the research area in focus in cloud computing e-government?

It is significant to note that this systematic literature review specifically focuses on adopting cloud services in e-governments but not in other fields like healthcare, manufacturing, or retail. Hence, during the procedure of extracting the primary studies, other fields of research emerged in the literature. The fields also discussed cloud computing in their way; however, the extraction process was mainly on empirical articles that concentrated on e-governments or the public sector. The benefits of cloud services are mentioned when looking at the growth of publications in the public sector or e-governments. It could be because it needs lower infrastructure costs while performing well in ultra-large-scale computing, flexibility, scalability, on-demand services, and virtualization (Li et al., 2021). Therefore, it has become an efficient solution to e-government development issues like rising IT costs. According to the studies extracted, the focus areas were as follows:

Organizational models that will help in adopting cloud services (Mohammed et al., 2017b; Salam & Ali, 2020; Shafique et al., 2017). They specify the determinants to be considered for cloud adoption. Adoption of organizational innovation is key as it improves the productivity of an organization, further enhancing economic growth while lowering inequality (Ali et al., 2018b; Damanpour et al., 2018; park & Choi, 2019). These studies focused on the organizational factors that are significant for adopting cloud services in e-governments. According to a study, the organizational adoption procedure is complex and challenging (Wisdom et al., 2014). Adoption starts from an organization's initial awareness and examination of the innovation. Successful adoption is later seen when the innovation is accepted and integrated into the firm, and individuals continue to use the technology for some time (Hameed et al., 2012).

Behavioral models examine the individual behavior towards the adoption of cloud computing (Alkhwaldi et al., 2017; Lian, 2015; Sivathanu, 2018). It brings out the role of humans in the adoption of e-government cloud services. Employees of an organization play a role in internal issues or opportunities in an organization (Sharma et al., 2020). In adopting innovations, the study points out that apart from the firm's decision to pursue adoption, the staff's acceptance and initiation of their processes are also significant (Wisdom et al., 2014). It is because individuals have difficulty deciding the right innovations for solving specific issues or making adoption decisions. Besides, employee resistance to information technology can be a barrier to innovation adoption (Sharma et al., 2020). Therefore, individual characteristics can provide a comprehensive view of the adoption of cloud services (Ali & Osmanaj, 2020). However, there are not many studies focusing on the individual level of cloud adoption (AlKharusi & Al-Badi, 2016).

A framework for cloud adoption evaluating the procedure and factors for adoption was discussed in a study (Junior et al., 2020; Shukur et al., 2018). From this study, it was seen that very few studies adopted a framework. Frameworks allow organizations to follow policies, standards, and guidelines (Chang et al., 2016). Moreover, they help organizations overcome technical and organizational challenges. For instance, a study had extended the technology acceptance model and TOE for cloud adoption (Gangwar et al., 2015). While for secure cloud adoption, a framework was also developed to protect data (Chang & Ramachandran, 2015)

This study also found some articles from developed countries (Ali et al., 2015; Polyviou & Pouloudi, 2015), with the rest concentrating on developing countries. Accordingly, there have been varying studies on cloud adoption in different parts of the world, with a higher percentage (50%) for developing nations compared to lower than 155 for developed nations (Vu et al., 2020). It may be one reason for the higher number of articles from developing nations. Besides, adoption of cloud services is mentioned to be slow for public sectors, with most being at the initial stages (Kuiper et al., 2014; Nanos et al., 2019). Therefore, the slowness in developing nations is due to the lack of a favorable environment for the utilization of cloud services (Vu et al., 2020). However, current governments are following the adoption trend of cloud services (Mohammed et al., 2020).

RQ2: How is cloud computing used to improve service delivery in e-governments (benefits)?

Cloud computing with its models has a lot to offer for governments and the public sector. Cloud computing is attractive because it eliminates the requirements for clients to plan, allowing utilization of resources only when in demand. Cloud computing promises to furnish every functionality of the existing information technology services model while lowering the upfront costs of computing that make organizations shy away from utilizing

cutting-edge IT services. Cloud pulls resources together like hardware, development platforms, and/or services. It can be exploited via a pay-per-use model through customized service level agreements. Cloud computing hence provides the ability of seamless access to resources. Many governments struggle to manage citizen data, improve service delivery, and enlarge their communication links through e-government. There are issues like data duplication, fragmentation, traditional infrastructure, more costs on modernization, poor performance, security, and privacy. A study agrees that cloud services can help enhance the quality of services provided to citizens from e-government solutions, manage huge data, and offer flexibility and freedom (Ali et al., 2014; Mohammed & Ibrahim, 2015b).

As mentioned in this article, utilizing cloud computing can help handle the issues mentioned above, but the bottom line is adopting the technology for use.

Based on the few issues reviewed, this study mentions how cloud computing can help benefit e-governments in various ways.

- Cost reduction- cloud computing is anticipated to reduce the cost of acquiring physical hardware, hence saving financial resources for organizations (Ali et al., 2015; Lian, 2015; Liang et al., 2017; Shukur et al., 2018). Accordingly, cost reduction is a promise achieved by adopting cloud services in organizations with a positive influence (Aziz et al., 2013; Kuiper et al., 2014; Mohammed & Ibrahim, 2015a; Mohammed & Ibrahim, 2015b). Hence, cloud adoption can lower maintenance and infrastructure costs while enhancing the availability of services. It is possible by using an outsourcing model that permits the renting of resources and paying only for the services used (Alkhater et al., 2014). Any upgrades and maintenance are passed to the third party for responsibility and saving on costs.

- Lower IT infrastructure- this means that the cost of acquiring the hardware will be low (Ali et al., 2015). This factor is linked to the first factor on cost reduction. Accordingly, lowering costs lowers infrastructure costs (Mohammed & Ibrahim, 2015a).

- Provide improved services- cloud computing will help lower risks and enable accessibility of data anytime and anywhere (Ali et al., 2015; Lian, 2015; Shukur et al., 2018). In turn, this will lead to better management of services and improved efficiency. When government services go online, it enhances the quality of services in the areas of accessibility, time, and content (Dash & Pani, 2016). With cloud computing, the increase of user loads only needs the addition and subtraction of network load rather than the addition of hardware (Mohammed & Ibrahim, 2015a).

- Remote accessibility- cloud computing will permit access to rural and remote areas, which increases audience reach (Ali et al., 2015; Liang et al., 2017; Shukur et al., 2018). It also enables sharing of information. According to a study, since cloud

services are web and internet-based, it brings accessibility via various internet-enabled gadgets like tablets, laptops, and traditional computers, among others (Mohammed & Ibrahim, 2015a; Tweneboah-Koduah et al., 2014).

- Backup and disaster recovery- cloud computing will enable functions to operate even amidst unexpected eventualities (Ali et al., 2015; Liang et al., 2017). The backup plan will help provide recovery when such incidents occur. Accordingly, a study adds that backup and restores done on cloud services are easier than those managed on physical storage (Dash & Pani, 2016; Mohammed & Ibrahim, 2015b). Hence, the cloud process is simpler as compared to the traditional process.

RQ3: What factors, methods, levels of implementation, data analysis techniques, and methodologies are available, and what is the gap for cloud computing in e-governments?

All the articles extracted in this study have highlighted significant factors for cloud adoption. It refers to the factors contributing to the successful adoption of cloud services in governments. According to most studies, the elements related to the adoption of cloud services fall into three main categories of technological, organizational, and environmental levels (Ali et al., 2015; Ji & Liang, 2016; Liang et al., 2017; Polyviou & Pouloudi, 2015; Shafique et al., 2017). However, some studies evaluated the factors based on behavioral factors like performance expectancy, social influence, facilitating conditions, perceived risk, trust, and security (Alrashed & Alotaibi, 2017; Lian, 2015; Salam & Ali, 2020; Sivathanu, 2018). Other researchers considered different elements. For instance, Wahsh and Dhillon (2015a) grouped the factors in terms of technical and non-technical elements, where the technical entails elements like security, trust, compatibility, and complexity, and non-technical elements include top management support, IT knowledge, relative advantage, and technological readiness. Additionally, Wu et al. (2016) explained determinants in the form of technological, business, and management factors. One study explores the adoption of cloud from a framework (Junior et al., 2020). Shukur et al. (2018) explore the factors from a framework and highlight the significance of technological, organizational, and environmental elements. Accordingly, other research has also pointed out the significance of environmental, organizational, and technological factors as key factors in the adoption of cloud services (Kuiper et al., 2014). Other researchers have also agreed that organizational, technical, and environmental factors have an impact on the adoption of cloud services (Al Hadwer et al., 2021; Albugmi et al., 2016; Ji & Liang, 2016; Scholtz et al., 2016).

On the level of implementation, the articles extracted for this study fell into two main levels: organizational and individual. Accordingly, 22 articles concentrated on the organizational perspective of adoption, while only six articles considered adoption from the individual perspective (Appendix A). There were no studies that merged both levels. Adoption is a decision by a person to utilize innovation for the first time, impacted by

attributes of the innovation, individual elements, and contextual factors (Sun & Jeyaraj, 2013). Accordingly, the adoption of innovations affects both the organizations as well as the individuals (Hameed et al., 2012; Wisdom et al., 2014). Organizations are deemed complex, while individuals have weights and may fail to choose the right innovation (Wisdom et al., 2014). Different researchers have employed several data analysis techniques. These include Partial Least Squares Structural Equation Modelling (PLS-SEM), factor analysis, Statistical Packages for Social Sciences (SPSS), parsimonious model, MATLAB, Principal component analysis with varimax rotation, ATLAS.ti, Manual & Leximancer visual text tool, and logistic regression. However, PLS-SEM was the most employed analysis tool, as shown in Appendix A. According to a study, PLS-SEM is mostly preferred as it attains high extents of statistical power while exhibiting improved convergence behavior (Hair Jr et al., 2014). In addition, it is good for complex models that may have many relationships (Hwang et al., 2016). Moreover, because most studies were predicting models, PLS-SEM suits the prediction of theories (Hair et al., 2013).

Methodologies have also been utilized in the extracted studies. This study found that several researchers used the quantitative method with surveys for their data collection. At the same time, the qualitative and mixed methods have not been largely used in cloud adoption in e-government specifically (Figure 4). Only three studies employed mixed methods (Al Mudawi et al., 2019; Maluleka & Ruxwana, 2016; Oguntala et al., 2017). Data gathering through surveys and analysis using the SEM method have been the most employed methods. The quantitative method has been relevant in most studies in this article, and a study mentions that this approach is more relevant when studying adoption issues at the organizational level (Choudrie & Dwivedi, 2005). It could be a reason why most studies were quantitative.

CONCLUSIONS

This study started with the motivation to understand cloud computing in e-governments and how cloud computing can be adopted to support government services. It brought the opportunity to first perform a systematic review on cloud computing in e-governments and know the progress in adoption. This study, in general, analyzed 654 studies from various secondary materials. The articles were narrowed down to 94, and finally to 28 relevant articles for this research. Our analysis reveals that very few empirical studies exist on the adoption of cloud services. The organizational adoption of cloud computing started around 2011, but the researchers could only find the first empirical study from 2015. Therefore, the study sought to explore significant factors for cloud adoption to implement e-governments. While most of our papers are specifically on adoption factors with empirical support, the results reveal that most of these studies were conducted in developing countries. The study also reveals that most studies have concentrated on quantitative methods using

surveys, with only a few using qualitative methods with case studies and semi-structured interviews. This study also notes that the concentration on identifying factors has mostly been done using quantitative procedures like structural equation modeling and regression analysis. The findings indicate that researchers have mostly resorted to employing the TOE (13 studies) and DOI (12 studies) frameworks for studying the adoption factors. Nevertheless, the researchers have also seen studies using UTAUT and TAM. Some studies have equally combined the models for better understanding. Technological, environmental, and organizational factors have been the most cited elements in research. Recent studies have also emphasized the role of trust in cloud services, as this will influence willingness for adoption.

In developing countries, there is significant growth in emerging technologies. The issues mentioned include IT infrastructure, cost reductions, backup and recovery, availability, and accessibility. For instance, cloud adoption for e-invoices in Taiwan mentions access, availability of infrastructure, security, safety mechanisms, privacy, and data confidentiality, among issues hindering adoption. The utilization of cloud services in governments can help handle such issues and bring improved service delivery. Considering the factors identified in this study can help developing nations adopt cloud services.

SUGGESTIONS FOR FUTURE WORK

This study has examined how cloud computing can contribute to e-government issues. The initial keyword searches for this study show that cloud computing has so many possible solutions for healthcare, governments, manufacturing, and retail. This study, however, concentrated on electronic governments. There are many applications for cloud computing in e-governments; however, in a decentralized structure without trust, the issues in e-governments may not be solved. Furthermore, cloud computing has evolved with various service models (IaaS, PaaS, SaaS), and the adoption of a good service will help handle infrastructure and cost issues in e-governments. From the outcomes of this survey and the study observations, this article presents the following research directions for cloud computing in e-governments that are worth considering for further evaluation.

Trust in Cloud computing: Trust has been mentioned as an issue in cloud computing, and it is an area that needs much improvement. This study shows that very few studies have considered the element of trust in the adoption of cloud computing in e-governments. Little has been discussed about this factor concerning decisions to adopt cloud services (Alrashed & Alotaibi, 2017). Trust can act as a moderator for the adoption of cloud services. Governments are least trusted in storing confidential and classified details on the internet. There is difficulty controlling sensitive information as a third party provides the services. Trust is related to levels of confidence (Sivapragash et al., 2019; Sivapragash et al., 2012). While there has been a good amount of research evaluating determinants for

cloud computing, very few studies have evaluated the causal elements. Thus, there is a need for future researchers to consider trust as the main factor, moderator, and/or mediator to fill this gap in the literature.

Human and social factors for adoption: As mentioned earlier, and from this study, very few researchers have considered the element of humans in the adoption of cloud computing (Alkhwaldi et al., 2017; Lagzian et al., 2018). Furthermore, only one study mentions the social factor as an element for cloud adoption (Alkhwaldi et al., 2017). Hence, there is a need to explore the human and social elements for cloud adoption in governments.

Behavioral models for adoption: This study also discovered that only a few researchers did empirical studies on behavioral models for the adoption of cloud services in e-governments (Alrashed & Alotaibi, 2017; Sivathanu, 2018). Hence, research needs to consider these models for government adoption studies.

This study found that most researchers have done quantitative studies. This methodology is very predominant in adoption studies. However, there is a need to consider using mixed methods for research studies related to cloud adoption in e-governments. Information system researchers have promoted the utilization of mixed methods for stronger validity and reliable outcomes (Ali & Osmanaj, 2020).

The SLR shows minimal studies in the domain of cloud computing in e-governments. However, more studies rose in 2020 as compared to 2019. It means there is a need to further grow the research in cloud computing in governments and public sectors.

This study also found frameworks with empirical results. However, very few studies utilized this approach. Frameworks are good for a holistic view at both organizational and individual levels. This study did not find frameworks from an individual perspective with empirical results. The frameworks adopted were from the organizational perspective. It is another worth area consideration. Frameworks with empirical studies can strengthen findings and broaden the application of cloud computing in various contexts.

ACKNOWLEDGEMENT

REFERENCES

Al-Rawahna, A. S. M., Hung, C. W., & Chen, S. C. (2018). Readiness of government organizations for cloud-computing age: An empirical evidence from Jordan. *Journal of Business and Management Sciences, 6*(4), 152-162. https://doi.org/10.12691/jbms-6-4-3

Al Hadwer, A., Tavana, M., Gillis, D., & Rezania, D. (2021). A systematic review of organizational factors impacting cloud-based technology adoption using technology-organization-environment framework. *Internet of Things, 15*, Article 100407. https://doi.org/10.1016/j.iot.2021.100407

Al Mudawi, N., Beloff, N., & White, M. (2019). Cloud computing in government organizations-towards a new comprehensive model. In *2019 IEEE SmartWorld, Ubiquitous Intelligence & Computing, Advanced & Trusted Computing, Scalable Computing & Communications, Cloud & Big Data Computing, Internet of People and Smart City Innovation (SmartWorld/SCALCOM/UIC/ATC/CBDCom/IOP/SCI)* (pp. 1473-1479). IEEE Publishing. https://doi.org/10.1109/SmartWorld-UIC-ATC-SCALCOM-IOP-SCI.2019.00266

Albugmi, A., Walters, R., & Wills, G. (2016). A framework for cloud computing adoption by Saudi government overseas agencies. In *2016 Fifth International Conference on Future Generation Communication Technologies (FGCT)* (pp. 1-5). IEEE Publishing. https://doi.org/10.1109/FGCT.2016.7605063

Alharbi, F., Atkins, A., & Stanier, C. (2016). Understanding the determinants of cloud computing adoption in Saudi healthcare organisations. *Complex & Intelligent Systems, 2*(3), 155-171. https://doi.org/10.1007/s40747-016-0021-9

Ali, K. E., Mazen, S. A., & Hassanein, E. (2018a). A proposed hybrid model for adopting cloud computing in e-government. *Future Computing and Informatics Journal, 3*(2), 286-295. https://doi.org/10.1016/j.fcij.2018.09.001

Ali, K. E., Mazen, S. A., & Hassanein, E. E. (2018b). Assessment of cloud computing adoption models in e-government environment. *International Journal of Computational Intelligence Studies, 7*(1), 67-92. https://doi.org/10.1504/IJCISTUDIES.2018.090168

Ali, O., & Osmanaj, V. (2020). The role of government regulations in the adoption of cloud computing: A case study of local government. *Computer Law & Security Review, 36*, Article 105396. https://doi.org/10.1016/j.clsr.2020.105396

Ali, O., Soar, J., & Yong, J. (2014). Impact of cloud computing technology on e-government. In *International conference on information and software technologies* (pp. 272-290). Springer. https://doi.org/10.1007/978-3-319-11958-8_22

Ali, O., Soar, J., Yong, J., McClymont, H., & Angus, D. (2015). Collaborative cloud computing adoption in Australian regional municipal government: An exploratory study. In *2015 IEEE 19th International Conference on Computer Supported Cooperative Work in Design (CSCWD)* (pp. 540-548). IEEE Publishing. https://doi.org/10.1109/CSCWD.2015.7231017

Alismaili, S. Z., Li, M., Shen, J., Huang, P., He, Q., & Zhan, W. (2020). Organisational-level assessment of cloud computing adoption: Evidence from the Australian SMEs. *Journal of Global Information Management (JGIM), 28*(2), 73-89. https://doi.org/10.4018/JGIM.2020040104

Alkhalil, A., Sahandi, R., & John, D. (2017). An exploration of the determinants for decision to migrate existing resources to cloud computing using an integrated TOE-DOI model. *Journal of Cloud Computing, 6*(1), 1-20. https://doi.org/10.1186/s13677-016-0072-x

AlKharusi, M. H., & Al-Badi, A. H. (2016). IT personnel perspective of the slow adoption of cloud computing in public sector: Case study in Oman. In *2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC)* (pp. 1-8). IEEE Publishing. https://doi.org/10.1109/ICBDSC.2016.7460364

Alkhater, N., Wills, G., & Walters, R. (2014). Factors influencing an organisation's intention to adopt cloud computing in Saudi Arabia. In *2014 IEEE 6th international conference on cloud computing technology and science* (pp. 1040-1044). IEEE Publishing. https://doi.org/10.1109/CloudCom.2014.95

Alkhwaldi, A., Kamala, M., & Qahwaji, R. (2017). From e-govemment to cloud-government: Challenges of Jordanian citizens' acceptance for public services. In *2017 12th International Conference for Internet Technology and Secured Transactions (ICITST)* (pp. 298-304). IEEE Publishing. https://doi.org/10.23919/ICITST.2017.8356405

Alrashed, M. A., & Alotaibi, M. B. (2017). The role of trust in the acceptance of government cloud: An empirical study. *International Journal of Technology Diffusion (IJTD), 8*(3), 1-19. https://doi.org/10.4018/IJTD.2017070101

Anuradha, M., Jayasankar, T., Prakash, N., Sikkandar, M. Y., Hemalakshmi, G., Bharatiraja, C., & Britto, A. S. F. (2021). IoT enabled cancer prediction system to enhance the authentication and security using cloud computing. *Microprocessors and Microsystems, 80*, Article 103301. https://doi.org/10.1016/j.micpro.2020.103301

Attaran, M., & Woods, J. (2018). Cloud computing technology: A viable option for small and medium-sized businesses. *Journal of Strategic Innovation & Sustainability, 13*(2), 94-106.

Avram, M. G. (2014). Advantages and challenges of adopting cloud computing from an enterprise perspective. *Procedia Technology, 12*, 529-534. https://doi.org/10.1016/j.protcy.2013.12.525

Awa, H. O., Ojiabo, O. U., & Orokor, L. E. (2017). Integrated technology-organization-environment (TOE) taxonomies for technology adoption. *Journal of Enterprise Information Management, 30*(6), 893-921.

Aziz, M. A., Abawajy, J., & Chowdhury, M. (2013). The challenges of cloud technology adoption in e-government. In *2013 International Conference on Advanced Computer Science Applications and Technologies* (pp. 470-474). IEEE Publishing. https://doi.org/10.1109/ACSAT.2013.98

Bayramusta, M., & Nasir, V. A. (2016). A fad or future of IT?: A comprehensive literature review on the cloud computing research. *International Journal of Information Management, 36*(4), 635-644. https://doi.org/10.1016/j.ijinfomgt.2016.04.006

Chang, V., Kuo, Y. H., & Ramachandran, M. (2016). Cloud computing adoption framework: A security framework for business clouds. *Future Generation Computer Systems, 57*, 24-41. https://doi.org/10.1016/j.future.2015.09.031

Chang, V., & Ramachandran, M. (2015). Towards achieving data security with the cloud computing adoption framework. *IEEE Transactions on Services Computing, 9*(1), 138-151. https://doi.org/10.1109/TSC.2015.2491281

Choudrie, J., & Dwivedi, Y. K. (2005). Investigating the research approaches for examining technology adoption issues. *Journal of Research Practice, 1*(1), D1-D1.

Damanpour, F., Sanchez-Henriquez, F., & Chiu, H. H. (2018). Internal and external sources and the adoption of innovations in organizations. *British Journal of Management, 29*(4), 712-730. https://doi.org/10.1111/1467-8551.12296

Dash, S., & Pani, S. K. (2016). E-Governance paradigm using cloud infrastructure: Benefits and challenges. *Procedia Computer Science, 85*, 843-855. https://doi.org/10.1016/j.procs.2016.05.274

Gangwar, H., Date, H., & Ramaswamy, R. (2015). Developing a cloud-computing adoption framework. *Global Business Review, 16*(4), 632-651. https://doi.org/10.1177/0972150915581108

Garad, A., & Santoso, J. (2017). Analysis and design of cloud computing for e-government in Yemen. *International Journal of Computer Engineering and Information Technology, 9*(8), 166.

Hadi, H., & Omar, M. (2021). Investigating the determinants of CC-SaaS adoption in Iraqi's public organisations from the perspective of IT professionals. *International Journal of Engineering and Technical Research, 14*, 130-143.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Planning, 46*(1-2), 1-12. https://doi.org/10.1016/j.lrp.2013.01.001

Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review, 26*(2), 106-121. https://doi.org/10.1108/EBR-10-2013-0128

Hameed, M. A., Counsell, S., & Swift, S. (2012). A conceptual model for the process of IT innovation adoption in organizations. *Journal of Engineering and Technology Management, 29*(3), 358-390. https://doi.org/10.1016/j.jengtecman.2012.03.007

Hosseini, S., Turhan, B., & Gunarathna, D. (2017). A systematic literature review and meta-analysis on cross project defect prediction. *IEEE Transactions on Software Engineering, 45*(2), 111-147. https://doi.org/10.1109/TSE.2017.2770124

Hsu, P. F., Ray, S., & Li-Hsieh, Y. Y. (2014). Examining cloud computing adoption intention, pricing mechanism, and deployment model. *International Journal of Information Management, 34*(4), 474-488. https://doi.org/10.1016/j.ijinfomgt.2014.04.006

Hwang, Y., Al-Arabiat, M., Shin, D. H., & Lee, Y. (2016). Understanding information proactiveness and the content management system adoption in pre-implementation stage. *Computers in Human Behavior, 64*, 515-523. https://doi.org/10.1016/j.chb.2016.07.025

Ji, H., & Liang, Y. (2016). Exploring the determinants affecting e-government cloud adoption in China. *International Journal of Business and Management, 11*(4), 81-90. https://doi.org/10.5539/ijbm.v11n4p81

Junior, L. P., Cunha, M. A., Janssen, M., & Matheus, R. (2020). Towards a framework for cloud computing use by governments: Leaders, followers and laggers. In *The 21st Annual International Conference on Digital Government Research* (pp. 155-163). ACM Publishing. https://doi.org/10.1145/3396956.3396989

Kandil, A. M. N. A., Ragheb, M. A., Ragab, A. A., & Farouk, M. (2018). Examining the effect of TOE model on cloud computing adoption in Egypt. *The Business & Management Review, 9*(4), 113-123.

Kitchenham, B., & Charters, S. (2007). Guidelines for performing systematic literature reviews in software engineering (Technical Report EBSE). Keele University.

Kuiper, E., Van Dam, F., Reiter, A., & Janssen, M. (2014). Factors influencing the adoption of and business case for cloud computing in the public sector. In *eChallenges e-2014 Conference Proceedings* (pp. 1-10). IEEE Publishing.

Kyriakou, N., Euripides, L., & Paraskevi, D. (2020). Factors affecting cloud storage adoption by Greek municipalities. In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance* (pp. 244-253). ACM Publishing. https://doi.org/10.1145/3428502.3428537

Lagzian, M., Hemmat, Z., Rashki, M., & Aghadavood, S. (2018). *An investigation on effective factors of acceptance of cloud computing in iranian public services* (No. 279). EasyChair.

Li, G., Zhou, M., Feng, Z., Li, M., & Jiang, H. (2021). Research on key influencing factors of e-government cloud service satisfaction. *Wireless Personal Communications*, 1-19. https://doi.org/10.1007/s11277-021-08567-0

Lian, J. W. (2015). Critical factors for cloud based e-invoice service adoption in Taiwan: An empirical study. *International Journal of Information Management, 35*(1), 98-109. https://doi.org/10.1016/j.ijinfomgt.2014.10.005

Liang, Y., & Qi, G. (2017). The determinants of e-government cloud adoption: Multi-case analysis of China. *International Journal of Networking and Virtual Organisations, 17*(2-3), 184-201. https://doi.org/10.1504/IJNVO.2017.10004061

Liang, Y., Qi, G., Wei, K., & Chen, J. (2017). Exploring the determinant and influence mechanism of e-Government cloud adoption in government agencies in China. *Government Information Quarterly, 34*(3), 481-495. https://doi.org/10.1016/j.giq.2017.06.002

Liang, Y., Qi, G., Zhang, X., & Li, G. (2019). The effects of e-Government cloud assimilation on public value creation: An empirical study of China. *Government Information Quarterly, 36*(4), Article 101397. https://doi.org/10.1016/j.giq.2019.101397

Lynn, T., Fox, G., Gourinovitch, A., & Rosati, P. (2020). Understanding the determinants and future challenges of cloud computing adoption for high performance computing. *Future Internet, 12*(8), Article 135. https://doi.org/10.3390/fi12080135

Maluleka, S. M., & Ruxwana, N. (2016). Cloud computing as an alternative solution for South African public sector: A case for department of social development. In *New Advances in Information Systems and Technologies* (pp. 481-491). Springer. https://doi.org/10.1007/978-3-319-31232-3_45

Mohammed, F., & Ibrahim, O. (2015a). Models of adopting cloud computing in the e-government context: A review. *Jurnal Teknologi, 73*(2), 51-59. https://doi.org/10.11113/jt.v73.4193

Mohammed, F., & Ibrahim, O. B. (2015b). Drivers of cloud computing adoption for e-government services implementation. *International Journal of Distributed Systems and Technologies (IJDST), 6*(1), 1-14. https://doi.org/10.4018/ijdst.2015010101

Mohammed, F., Ibrahim, O., & Ithnin, N. (2016). Factors influencing cloud computing adoption for e-government implementation in developing countries: Instrument development. *Journal of Systems and Information Technology, 18*(3), 297-327. https://doi.org/10.1108/JSIT-01-2016-0001

Mohammed, F., Alzahrani, A. I., Alfarraj, O., & Ibrahim, O. (2017a). Cloud computing fitness for e-Government implementation: Importance-performance analysis. *IEEE Access, 6*, 1236-1248. https://doi.org/10.1109/ACCESS.2017.2778093

Mohammed, F., Ibrahim, O., Nilashi, M., & Alzurqa, E. (2017b). Cloud computing adoption model for e-government implementation. *Information Development, 33*(3), 303-323. https://doi.org/10.1177/0266666916656033

Mohammed, F., Olayah, F., Ali, A., & Gazem, N. A. (2020). The effect of cloud computing adoption on the sustainability of e-government services: A review. *International Journal of Advanced Science and Technology, 29*(5), 2636-2642.

Mousa, M. A. S. (2020). Determinants of cloud based e-government in Libya. *Journal of Critical Reviews, 7*(13), 2239-2248.

Nanos, I., Manthou, V., & Androutsou, E. (2019). Cloud computing adoption decision in E-government. In *Operational Research in the Digital Era–ICT Challenges* (pp. 125-145). Springer. https://doi.org/10.1007/978-3-319-95666-4_9

Oguntala, G. A., Abd-Alhameed, P., Raed, A., Odeyemi, D., & Janet, O. (2017). Systematic analysis of enterprise perception towards cloud adoption in the African states: The Nigerian perspective. *The African Journal of Information Systems, 9*(4), Article 1.

Park, H., & Choi, S. O. (2019). Digital innovation adoption and its economic impact focused on path analysis at national level. *Journal of Open Innovation: Technology, Market, and Complexity, 5*(3), Article 56. https://doi.org/10.3390/joitmc5030056

Polyviou, A., & Pouloudi, N. (2015). Understanding cloud adoption decisions in the public sector. In *2015 48th Hawaii International Conference on System Sciences* (pp. 2085-2094). IEEE Publishing. https://doi.org/10.1109/HICSS.2015.250

Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.

Salam, N. R. A., & Ali, S. (2020). Determining factors of cloud computing adoption: A study of Indonesian local government employees. *Journal of Accounting and Investment, 1*(2), 312-333. https://doi.org/10.18196/jai.2102151

Sallehudin, H., Aman, A. H. M., Razak, R. C., Ismail, M., Bakar, N. A. A., Fadzil, A. F. M., & Baker, R. (2020). Performance and key factors of cloud computing implementation in the public sector. *International Journal of Business and Society, 21*(1), 134-152. https://doi.org/10.33736/ijbs.3231.2020

Sallehudin, H., Razak, R., Ismail, M., Fadzil, A., & Baker, R. (2019). Cloud computing implementation in the public sector: Factors and impact. *Asia-Pacific Journal of Information Technology and Multimedia, 7*(2-2), 27-42. https://doi.org/10.17576/apjitm-2018-0702(02)-03

Scholtz, B., Govender, J., & Gomez, J. M. (2016). Technical and environmental factors affecting cloud computing adoption in the South African public sector. In *International Conference on Information Resources Management (CONF-IRM)* (pp. 1-14). AISeL.

Senyo, P. K., Addae, E., & Boateng, R. (2018). Cloud computing research: A review of research themes, frameworks, methods and future research directions. *International Journal of Information Management, 38*(1), 128-139. https://doi.org/10.1016/j.ijinfomgt.2017.07.007

Setiorini, A., Natasia, S. R., Wiranti, Y. T., & Ramadhan, D. A. (2021). Evaluation of the application of hospital management information system (SIMRS) in RSUD Dr. Kanujoso Djatiwibowo using the HOT-Fit method. In *Journal of Physics: Conference Series* (Vol. 1726, No. 1, p. 012011). IOP Publishing. https://doi.org/10.1088/1742-6596/1726/1/012011

Shafique, M. A., Mahmood, Y., Hameed, K., Malik, B. H., Cheema, S. N., & Tabassum, S. (2017). Determinants impacting the adoption of e-government information systems and suggesting cloud computing migration framework. *International Journal of Advanced Computer Science and Applications, 8*(9), 173-182. https://doi.org/10.14569/IJACSA.2017.080925

Sharma, M., Gupta, R., & Acharya, P. (2020). Analysing the adoption of cloud computing service: A systematic literature review. *Global Knowledge, Memory and Communication, 70*(1/2), 114-153. https://doi.org/10.1108/GKMC-10-2019-0126

Shukur, B. S., Ghani, M. K. A., & Burhanuddin, M. (2018). An analysis of cloud computing adoption framework for Iraqi e-government. *Culture, 9*(8), 104-112. https://doi.org/10.14569/IJACSA.2018.090814

Singh, P., Dwivedi, Y. K., Kahlon, K. S., Sawhney, R. S., Alalwan, A. A., & Rana, N. P. (2020). Smart monitoring and controlling of government policies using social media and cloud computing. *Information Systems Frontiers, 22*(2), 315-337. https://doi.org/10.1007/s10796-019-09916-y

Sivapragash, C., Padmanaban, S., Eklas, H., Holm-Nielsen, J. B., & Hemalatha, R. (2019). Location-based optimized service selection for data management with cloud computing in smart grids. *Energies, 12*(23), 1-16. https://doi.org/10.3390/en12234517

Sivapragash, C., Thilaga, S., & Kumar, S. S. (2012). Advanced cloud computing in smart power grid. In *IET Chennai 3rd International Conference on Sustainable Energy and Intelligent Systems (SEISCON 2012)* (pp. 356-361). IET Digital Library. https://doi.org/10.1049/cp.2012.2238

Sivathanu, B. (2018). An empirical study of cloud-based e-governance services adoption in India. *International Journal of Electronic Government Research (IJEGR), 14*(1), 86-107. https://doi.org/10.4018/IJEGR.2018010105

Sun, Y., & Jeyaraj, A. (2013). Information technology adoption and continuance: A longitudinal study of individuals' behavioral intentions. *Information & Management, 50*(7), 457-465. https://doi.org/10.1016/j.im.2013.07.005

Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K. (1990). *Processes of technological innovation*. Lexington books.

Tsaravas, C., & Themistocleous, M. (2011, May 30-31). Cloud computing and Egovernment: A literature review. In *European, Mediterranean & Middle Eastern Conference on Information Systems* (pp. 154-164). Athens, Greece.

Tuli, S., Tuli, S., Tuli, R., & Gill, S. S. (2020). Predicting the growth and trend of COVID-19 pandemic using machine learning and cloud computing. *Internet of Things, 11*, Article 100222. https://doi.org/10.1016/j.iot.2020.100222

Tweneboah-Koduah, S., Endicott-Popovsky, B., & Tsetse, A. (2014). Barriers to government cloud adoption. *International Journal of Managing Information Technology, 6*(3), 1-16. https://doi.org/10.5121/ijmit.2014.6301

Vaidya, S., Shah, N., Virani, K., & Devadkar, K. (2020). A survey: Mobile cloud computing in education. In *2020 5th International Conference on Communication and Electronics Systems (ICCES)* (pp. 655-659). IEEE Publishing. https://doi.org/10.1109/ICCES48766.2020.9138053

Vu, K., Hartley, K., & Kankanhalli, A. (2020). Predictors of cloud computing adoption: A cross-country study. *Telematics and Informatics, 52*, Article 101426. https://doi.org/10.1016/j.tele.2020.101426

Wahsh, M. A., & Dhillon, J. S. (2015a). An investigation of factors affecting the adoption of cloud computing for E-government implementation. In *2015 IEEE Student Conference on Research and Development (SCOReD)* (pp. 323-328). IEEE Publishing. https://doi.org/10.1109/SCORED.2015.7449349.

Wahsh, M. A., & Dhillon, J. S. (2015b). A systematic review of factors affecting the adoption of cloud computing for E-government implementation. *Journal of Engineering and Applied Sciences, 10*(23), 17824-17832.

Wang, C., Li, S., Cheng, T., & Li, B. (2020). A construction of smart city evaluation system based on cloud computing platform. *Evolutionary Intelligence, 13*(1), 119-129. https://doi.org/10.1007/s12065-019-00259-w

Wisdom, J. P., Chor, K. H. B., Hoagwood, K. E., & Horwitz, S. M. (2014). Innovation adoption: A review of theories and constructs. *Administration and Policy in Mental Health and Mental Health Services Research, 41*(4), 480-502. https://doi.org/10.1007/s10488-013-0486-4

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. In *Proceedings of the 18th international conference on evaluation and assessment in software engineering* (pp. 1-10). ACM Publishing. https://doi.org/10.1145/2601248.2601268

Wu, J., Ding, F., Xu, M., Mo, Z., & Jin, A. (2016). Investigating the determinants of decision-making on adoption of public cloud computing in e-government. *Journal of Global Information Management (JGIM), 24*(3), 71-89. https://doi.org/10.4018/JGIM.2016070104

Yadegaridehkordi, E., Nilashi, M., Shuib, L., Nasir, M. H. N. B. M., Asadi, S., Samad, S., & Awang, N. F. (2020). The impact of big data on firm performance in hotel industry. *Electronic Commerce Research and Applications, 40*, Article 100921. https://doi.org/10.1016/j.elerap.2019.100921

Yusof, M. M., Kuljis, J., Papazafeiropoulou, A., & Stergioulas, L. K. (2008). An evaluation framework for Health Information Systems: Human, organization and technology-fit factors (HOT-fit). *International Journal of Medical Informatics, 77*(6), 386-398. https://doi.org/10.1016/j.ijmedinf.2007.08.011

Zhang, H. (2020). The application of cloud computing in government management. In *IOP Conference Series: Materials Science and Engineering* (Vol. 750, No. 1, p. 012166). IOP Publishing. https://doi.org/10.1088/1757-899X/750/1/012166

APPENDIX A

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
1	Al Mudawi et al. (2019)	Factors affecting cloud adoption	Technological- compatibility, complexity, service quality, security, and relative advantage 2. Organizational- top management support, technological readiness, organizational size 3. Environmental -competitive pressure, regulations 4. Social attitude, trust, awareness	Organizational	TOE & DOI	Mixed method	SEM	400
2	Ali and Osmanaj (2020)	e-government services, Infrastructure, cost of data and applications, IT budget costs, software licensing and support, integration, and management	1. Technological – Cost, security concern 2. Organizational- top management support, organizational size, employees' knowledge 3. Environment – Government regulation, information intensity 4.Innovationcharacteristics-Compatibility, complexity 5. benefits characteristics-anticipated benefits	Organizational	TOE & DOI & DF	Quantitative	Factor analysis, SEM	480 IT staff

No.	Author	Issues/Themes	Factors	Level	Theory/Model	Methodology	Data Analysis Technique	Respondents
3	Wahsh and Dhillon, (2015a)	Factors affecting adoption of cloud for e-government implementation	1. Technological – Security, Trust, Compatibility, Complexity 2. non-technological factors – Top management support, IT knowledge, Technological readiness, Relative advantage	Organizational	TOE & DOI	Quantitative	SPSS with AMOS	234 IT experts
4	Polyviou and Pouloudi (2015)	Understanding cloud adoption in the public sector	1. Technological – Relative advantage, compatibility, complexity 2. Organizational – interoperability, business processes, environmental standards, transparency of process standards, security standards 3. Environment – Bureaucracy, political matters, legal issues	Organizational	TOE	Qualitative	Qualitative software	21 interviews across 6 European countries

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
5	Wu et al. (2016)	Decision-making determinants on public cloud adoption in e-government	1. Technical – alignment, adaptation, security 2. Business – cost-effectiveness, operational risk 3. Management – IT compliance, management controlling power	Organizational	Technical adoption theory and IT decision-making	Quantitative	SEM	227 CIOs from public sectors
6	Salam and Ali (2020)	Factors influencing adoption of cloud by government	1. Performance Expectations 2. Business expectations 3. Perception of Availability	Organizational	UTAUT	Quantitative	SEM	123 employees
7	Mohammed et al. (2017b)	Factors influencing cloud adoption in the public sector	1. Fitness- Relative advantage, compatibility, trialability, security 2. Viability- return on investment, asset specificity 3. Technological readiness- IT infrastructure, IT policy, and regulations	Organizational	Fit Viability & DOI	Quantitative	PLS SEM	296 IT staff

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
8	Kandil et al. (2018)	Effect of TOE on cloud adoption in Egypt	1. Technology – Relative advantage, Complexity, Compatibility, Security & Trust 2. Organizational- Top Management Support, Technology readiness, Maturity & Performance Issues 3. Environment- Competitive Pressure, Telecommunication Infrastructure, Internet Service Provider, Trading Partner support, Trading Partner Pressure	Organizational	TOE	Quantitative	PLS SEM	432 IT employees
9	Maluleka and Ruxwana (2016)	Cloud computing as an alternative for the South African public sector	Lack of support, user resistance, compatibility, migration cost, lack of approved standards, poor IT infrastructure	Organizational	DOI	Mixed methods	SPSS	28 questionnaires, 6 interviews
10	Al-Rawahna et al. (2018)	Readiness of government organizations for cloud computing	1. Top Management Support 2. Organizational Capability 3. Government Policy 4. Organizational Size 5. IT skills and Infrastructure	Organizational	TOE	Quantitative	PLS-SEM	132 IT staff

No.	Author	Issues/Themes	Factors	Level	Theory/Model	Methodology	Data Analysis Technique	Respondents
11	Vu et al. (2020)	Predictors of cloud adoption	Legal System Quality, Fixed Broadband Penetration, Advanced Digital Infrastructure, Digital Legacy Large Services	Organizational	Institutional	Quantitative	Parsimonious model	45 countries
12	Oguntala et al. (2017)	Perception toward cloud adoption	On-demand service deliver, guaranteed quality of service, scalability, and flexibility, data security, user-centric interface, user autonomy	Organizational	Literature	Mixed methods	Data processing software and MATLAB	200
13	Liang et al. (2019)	"Effects of e-government cloud assimilation on public value creation"	Depth, breadth, balanced fit, complementary fit, operational public value, strategic public value	Individual	IT assimilation theory, IT value theory, organizational ambidexterity theory	Quantitative	PLS SEM	158 IT directors and senior IS managers

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
14	Sivathanu (2018)	Elements affecting adoption of Digi Locker cloud-based e-governance	Performance expectancy, effort expectancy, facilitating conditions, social influence, perceived awareness, computer self-efficacy, multilingual option, perceived quality of information, perceived response, perceived trust	Individual	e-GAM and UTAUT models	Quantitative	PLS-SEM	80 citizens and students
15	Junior et al. (2020)	"Towards a framework for cloud computing use by governments"	Cloud characteristics	Individual	DOI and Institutional theory	Qualitative	spreadsheets	17 Managers and engineers in charge of Cloud Gov
16	Kyriakou et al. (2020)	"Factors affecting cloud storage adoption by Greek municipalities	Relative advantage, compatibility, complexity	Organizational	DOI	Quantitative	Principal component analysis	121 municipalities

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
17	Mousa (2020)	Determinants of cloud-based e-government	Technological, organizational, IT knowledge	Organizational	TOE & DOI	Quantitative	SEM	279 decision-makers
18	Garad and Santoso (2017)	Impact of using Cloud computing in e-government and infrastructure required	Performance, security and privacy, control, data transfer costs, accuracy and reliability	Organizational	Framework	Quantitative	SPSS	136 managers and IT employees
19	Ji and Liang (2016)	Exploring the determinants affecting e-government cloud adoption in China	Technology, organizational, and environment	Organizational	TOE & DOI	Qualitative	Qualitative analysis software	12 interviews
20	Shafique et al. (2017)	Elements affecting e-government and cloud migration	Technological- perceived benefits, IT infrastructure, complexity, Organizational- size, top management commitment and innovativeness, resource commitment Environmental- external pressure, regulatory environment, work overload	Organizational	TOE	Quantitative	Principal component factor analysis	175 respondents

No.	Author	Issues/ Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
21	Liang et al. (2017)		Technology driving- comparative advantage, technological concern Cloud provider support- cloud provider characteristic, cloud provider competence, cloud provider presence Organizational readiness- top management support, organizational scale, and complexity of informational resource Environmental stimulus- policy & regulation, industry standards, competition pressure, requirement of citizen, best practice, financial fund Cloud trust- initial trust, perceived benefit-based trust	Organizational	Grounded theory	Qualitative	Atlas's	24 government officials
22	Shukur et al. (2018)	Cloud adoption framework for Iraqi e-government	Technological- cost, scalability, flexibility, compatibility, complexity, security & privacy, resource utilization Organizational- top management support, IT infrastructure, IT human resources Environment- reliable, available, ownership, mobile access, migration Ease of use, Regulation issues	Organizational	TOE & TAM	Quantitative	Mean & SD	25 e-government staff

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
23	Lian (2015)	Cloud-based e-invoice adoption	Effort expectation, social influence, trust in e-government, perceived risk	Individual	UTAUT2	Quantitative	PLS SEM	251 respondents
24	Alkhwaldi et al. (2017)	Cloud-based e-government acceptance in Jordan	Technological, Human, Social, Finance	Individual	UTAUTA2	Quantitative	SPSS	164 respondents
25	Liang and Qi (2017)	Determinants of e-government cloud adoption in China	Environmental- financial commitment support, completeness of policy & standard, successful cases Organizational- top management support, organizational inertia, scale, and complexity of informational resources Technology task fit Technology- compatibility, competitive advantage, complexity	Organization	DOI, TOE, TAM, TTF	Qualitative: multicast	Atlas's	21 respondents

No.	Author	Issues/Themes	Factors	Level	Theory/ Model	Methodology	Data Analysis Technique	Respondents
26	Ali et al. (2015)	Collaborative cloud adoption in Australian municipal government	Technological- Cost, technology readiness, security Organizational- Size, top management support, employee knowledge Environment- Competitive pressure, regulation support, information intensity Innovation factors- Relative advantage, complexity, compatibility	Organizational	TOE & DOI	Qualitative	Manual & Leximancer visual text tool	21 interviews
27	Alrashed and Alotaibi (2017)	Trust in acceptance of government cloud	Performance expectancy, effort expectancy, social influence, trust, perceived risk	Individual	UTAUT	Quantitative	PLS-SEM	310 IT professional and technicians
28	Lagzian et al. (2018)	Effective factors for acceptance of cloud in Iran public services	Human- recipients' innovation, decision makers' knowledge Technological- relative advantage, test capability, compatibility, technology infrastructure, security, and privacy Organizational- information intensity, employee knowledge Environmental- External support, environmental infrastructure, competitive pressure	Organizational	TTF, Hot fit, DOI, & TOE	Quantitative	SPSS & Logistic regression	60 managers and IT experts